

LIBS and Remote Raman Spectroscopy References With Planetary Science Applications by LANL and Collaborators

Contents

LIBS Publications for Planetary Science	1
LIBS Planetary Science Abstracts	2
Remote Raman Spectroscopy Publications	11
Remote Raman Spectroscopy Abstracts	12
Combined LIBS and Raman Spectroscopy Publications.....	14
Combined LIBS and Raman Spectroscopy Abstracts	14

LIBS Publications for Planetary Science

Lanza N.L., Clegg S.M., Ollila A.M., Barefield J.E., Newsom H.E., Wiens R.C., and the ChemCam team (2010) Calibrating the ChemCam LIBS for Carbonate Minerals on Mars. *Appl. Optics* 49, C211-C217.

Clegg S.M., Wiens R.C., Barefield J.E., Sklute E., and Dyar M.D. (2009) Quantitative Remote Laser Induced Breakdown Spectroscopy by Multivariate Analysis. *Spectrochimica Acta B* 64, 79-88.

Thompson J., Wiens R.C., Clegg S., Barefield J., Vaniman D., and Newsom H. (2006) Remote LIBS Analyses of Zagami and DAG 476 Martian Meteorites. *J. Geophys. Res.*, 111, E05006, doi:10.1029/2005JE002578.

Radziemski L., Cremers D., Benelli K., Khoo C., and Harris R.D. (2005) Use of the vacuum ultraviolet spectral region for LIBS-based Martian geology and exploration. *Spectrochimica Acta B*, 60, 237-248.

Sallé, B. Cremers D.A., Maurice S., and Wiens R.C. (2005) Laser-induced breakdown spectroscopy for space exploration applications: Influence of ambient pressure on the calibration curves prepared from soil and clay samples. *Spectrochimica Acta B*, 60, 479-490.

Sallé, B. Cremers D.A., Maurice S., and Wiens R.C. (2005) Evaluation of a compact spectrograph for in-situ and stand-off laser-induced breakdown spectroscopy analyses of geological samples in Martian missions. *Spectrochim. Acta B* 60, 805-815.

Sallé B., Lacour J.-L., Vors E., Fichet P., Maurice S., Cremers D.A., and Wiens R.C. (2004) Laser-induced breakdown spectroscopy for Mars surface analysis : Capabilities at stand-off distance and detection of chlorine and sulfur elements. *Spectrochim. Acta B* 59, 1413-1422.

Arp Z.A., Cremers D.A., Harris R.D., Oschwald D.M., Parker G.R., and Wayne D.M. (2004) Feasibility of generating a useful laser-induced breakdown spectroscopy plasma on rocks at high pressure: preliminary study for a Venus mission. *Spectrochim. Acta B*, 59, 987-999.

Arp Z.A., Cremers D.A., Wiens R.C., Wayne D.M., Salle B., and Maurice S. (2004) Analysis of water ice and water ice/soil mixtures using laser-induced breakdown spectroscopy: Application to Mars polar exploration. *Applied Spectrosc.*, 58, 897-909.

Brennetot R., Lacour J.L., Vors E., Rivoallan A., Vailhen D., and Maurice S. (2003) Mars analysis by laser-induced breakdown spectroscopy (MALIS): Influence of Mars atmosphere on plasma emission and study of factors influencing plasma emission with the use of Doehlert designs. *Appl. Spectrosc.* 57, 744-752.

Wiens R.C., Seelos F.P. IV, Ferris M.J., Arvidson R.E., Cremers D.A., Blacic J.D., and Deal K. (2002) Combined remote mineralogical and elemental identification from rovers: Field tests using LIBS and VISIR. *J. Geophys. Res. Planets.*, 10.1029/2000JE001439, 30 August.

Knight A.K., Scherbarth N.L., Cremers D.A., and Ferris M.J. (2000) Characterization of laser-induced breakdown spectroscopy (LIBS) for application to space exploration. *Appl. Spectrosc.* 54, 331-340.

Blacic, J.D., Pettit D.R., and Cremers D.A. (1992) Laser-Induced Breakdown Spectroscopy for Remote Elemental Analysis of Planetary Surfaces. Proceedings of the International Symposium on Spectral Sensing Research, Maui, HI, November 15-20.

LIBS Planetary Science Abstracts

Wiens R.C. (2010) The Mars Science Laboratory Mission: Goals, mission overview, and potential landing sites. Second Annual Symposium on Planetary Exploration, May 21-22, 2010, Chiba, Japan.

Clegg S.M., Forni O., Wiens R.C., and Maurice S. (2010) Mars geochemical analysis by multivariate analysis. Joint Statistics Meeting, Vancouver, British Columbia, Canada.

Bridges N.T., Wiens R.C., Maurice S., and Clegg S. (2010) The use of ChemCam on MSL for sedimentological and stratigraphic studies. First International Conference on Mars Sedimentology and Stratigraphy, April 19-21, 2010, El Paso, TX.

Ollila A.M., Blank J.G., McKay C.P., Wiens R.C., Maurice S., Clegg S.M., Lanza N.L., Newsom H.E., King P.L., and the ChemCam team (2010) Continuing the search for organics on Mars using ChemCam on the Mars Science Laboratory. Astrobiology Science Conference 2010, April 27-30, Houston, TX.

Blank J.G., Ollila A.M., Lanza N.L., McKay C.P., Wiens R.C., Maurice S., Clegg S.M., and the ChemCam Team (2010) Organic detection using ChemCam, the first interplanetary LIBS. LIBS 2010, Sept. 13-17, Memphis, TN.

Mezzacappa A., Nortier L.-M., Clegg S., Wiens R.C., Melikechi N. (2010) Investigation of LIBS under low pressure for application to planetary exploration. LIBS 2010, Sept. 13-17, Memphis, TN.

Tucker J.M., Dyar M.D., Schaefer M.W., Clegg S.M., Wiens R.C. (2010) Optimization of laser-induced breakdown spectroscopy for rapid geochemical analysis. LIBS 2010, Sept. 13-17, Memphis, TN.

Ollila A.M., Wiens R.C., Lasue J., Newsom H.E., Clegg S.M. (2010) Accurate classification of rocks and quantification of elemental abundances at variable distance using the ChemCam LIBS instrument. LIBS 2010, Sept. 13-17, Memphis, TN.

Lasue J., Wiens R.C., Forni O., Clegg S.M. (2010) Comparison of multivariate data representation and quantification techniques for ChemCam LIBS on Mars. LIBS 2010, Sept. 13-17, Memphis, TN.

Lanza N.L., Deans M.D., Wiens R.C., Clegg S.M., Humphries S.D., Newsom H.E., Rampe E.B., and Ollila A.O. (2010) Using LIBS to determine composition of natural rock coatings for planetary exploration. LIBS 2010, Sept. 13-17, Memphis, TN.

Humphries S.D., Tucker J.M., McInroy R.E., Obrey S.J., Wiens R.C., Dyar M.D., and Clegg S.M. (2010) a LIBS elemental emission library for ChemCam at 7 m. LIBS 2010, Sept. 13-17, Memphis, TN.

Vaniman D., Wiens R.C., Clegg S., and Maurice S. (2010) Sample analysis in the lunar environment using Laser Induced Breakdown Spectroscopy. Lunar Science Forum, July 20-22, Mountain View, CA.

Fabré C., Maurice S., Wiens R., and Sautter V. (2010) ChemCam LIBS instrument: Complete characterization of the onboard calibration silicate targets (MSL rover). *Lunar Planet. Sci. XLI*, 1835.

<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/1835.pdf>

Cousin A., Maurice S., Forni O., Gasnault O., Dalmau J., Saccoccio M., Wiens R., and the ChemCam team (2010) Laser induced breakdown spectroscopy (LIBS) library under Martian conditions. *Lunar Planet. Sci. XLI*, 1983

<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/1983.pdf>

Perkins J.J., Sharma S.K., Lienert B.R., Clegg S.M., and Wiens R.C. (2010) Improvement in qualitative and quantitative LIBS analysis of elemental compositions of basalts. *Lunar Planet. Sci. XLI*, 1517. <http://www.lpi.usra.edu/meetings/lpsc2010/pdf/1517.pdf>

Blank J.G., Clegg S.M., Barefield J.E., McKay C.P. and Wiens R.C. (2010) Laboratory exploration of organic and inorganic carbon by laser-induced breakdown spectroscopy (LIBS): Relevance for planetary astrobiology missions. *Lunar Planet. Sci. XLI*, 2485.

<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/2485.pdf>

Tucker J.M., Dyar M.D., Schaefer M.W., Clegg S.M., and Wiens R.C. (2010) Multivariate LIBS analysis of geologic materials. *Lunar Planet. Sci. XLI*, 1970.

<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/1970.pdf>

Wiens R.C., Clegg S.M., Bender S., Lanza N., Barraclough B., Perez R., Maurice S., Dyar M.D., Newsom H., and the ChemCam team (2010) Progress on calibration of the ChemCam LIBS instrument for the Mars Science Laboratory (MSL) rover. *Lunar Planet. Sci. XLI*, 2205.

<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/2205.pdf>

Humphries S.D., Clegg S.M., McInroy R.E., Obrey S.J., Wiens R.C., and Dyar M.D. (2010) A LIBS elemental emission library for ChemCam at 7 m. *Lunar Planet. Sci. XLI*, 2096.

<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/2096.pdf>

Clegg S.M., Barefield J.E., Wiens R.C., Sharma S.K., Misra A.K., Dyar M.D., Lambert J., Smrekar S., and Treiman A. (2010) Venus geochemical analysis by remote laser induced

breakdown spectroscopy (LIBS). *Lunar Planet. Sci. XLI*, 1631.
<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/1631.pdf>

Lanza N.L., Deans M., Clegg S.M., Humphries S.D., McInroy R.E., Wiens R.C., and Newsom H.E. (2010) Evaluating LIBS as a geochemical reconnaissance tool for the K10 Lunar rover. *Lunar Planet. Sci. XLI*, 2613.
<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/2613.pdf>

Gallegos Z.E., Lanza N., Newsom H.E., Ollila A.M., King N.P., Clegg S.M., Wiens R.C., Vaniman D., Humphries S.D., McInroy R.E., Osinski G.R., and Lee P. (2010) Using laser induced breakdown spectroscopy (LIBS) to assess geologic samples associated with a terrestrial impact structure as an analogue for future planetary exploration. *Lunar Planet. Sci. XLI*, 2365.
<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/2365.pdf>

Anderson R.B., Morris R.V., Humphries S.D., Clegg S.M., Wiens R.C., Bell J.F. III, and Mertzman S.A. (2010) Partial least squares and neural networks for quantitative calibration of laser-induced breakdown spectroscopy (LIBS) of geologic samples. *Lunar Planet. Sci. XLI*, 2013.
<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/2013.pdf>

Wiens R.C., Maurice S., and Clegg S. (2009) ChemCam on MSL: Status and Initial Calibrations. Fall AGU.

Forni O., Clegg S., Wiens R.C., Maurice S., and Gasnault O. (2009) Multivariate analyses of ChemCam first calibration samples. Abstract #1523, *Lunar Planet. Sci. XL*, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2009/pdf/1523.pdf>

Newsom H.E., Ollila A.M., Lanza N.L., King P., Gallegos Z., Osinski G.R., Clegg S.M., Wiens R.C., Vaniman D., Lee P., Glass B.J., Walker E., Thackrey S., Parnell J. (2009) Simulated rover field test at the Haughton Impact Crater field station. Abstract #1446, *Lunar Planet. Sci. XL*, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2009/pdf/1446.pdf>

Clegg S.M., Barefield J.E., Humphries S.D., Wiens R.C., Vaniman D.T., Sharma S.K., Misra A.K., Dyar M.D. (2009) Remote laser induced breakdown spectroscopy (LIBS) geochemical investigation under Venus atmospheric conditions. Fall AGU.

Dyar M.D., Tucker J.M., Clegg S.M., Schaefer M.W., Wiens R.C., and Barefield J.E. II (2009) Probing Martian surface chemistry with LIBS: Major and minor element analyses with laser-induced breakdown spectroscopy. *New Martian Chemistry Workshop*, Medford, MA.

Tucker J.M., Dyar M.D., Clegg S.M., Schaefer M.W., Wiens R.C., and Barefield J.E. II (2009) LIBS Analysis of minor elements in geologic samples. Abstract #2024, *Lunar Planet. Sci. XL*, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2009/pdf/2024.pdf>

Wiens R.C., Clegg S., Bender S., Lanza N., Barraclough B., Perez R., Maurice S., Dyar M.D., Newsom H., and the ChemCam team (2009) Initial Calibration of the ChemCam LIBS instrument for the Mars Science Laboratory (MSL) rover. Abstract 1461. *Lunar Planet. Sci. XL*, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2009/pdf/1461.pdf>

Perkins J.J., Sharma S.K., Clegg S.M., Misra A.K., Wiens R.C., and Barefield J.E. (2009) Remote laser-induced breakdown spectroscopy (LIBS) analysis of hydrated sulfates. Abstract 1397. *Lunar Planet Sci. XL*, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2009/pdf/1397.pdf>

Fabre C., Maurice S., Sautter V., Wiens R., Dubessy J., Boiron M.C., and the ChemCam team (2009) Onboard calibration silicon targets for the ChemCam LIBS instrument (MSL Rover). Abstract #1502, *Lunar Planet. Sci. XL*, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2009/pdf/1502.pdf>

Vaniman D.T., Clegg S., Lanza N., Newsom H., Wiens R.C., and the ChemCam team (2009) Fabrication of sulfate-bearing ceramic calibration targets for the ChemCam laser spectroscopy instrument, Mars Science Laboratory. *Lunar Planet Sci. XL*. Abstract 2296. The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2009/pdf/2296.pdf>

Wiens R.C., Clegg S., Barefield J. II, Vaniman D., Lanza N., Newsom H., Herkenhoff K., Bridges N., Blaney D., Maurice S., Gasnault O., Blank J., Dyar M.D., Milliken R., Grotzinger J., Crisp J., and the ChemCam and MSL teams (2008) ChemCam remote analyses and imaging on the Mars Science Laboratory 2007 'slow motion' field test. Abstract #1500. *Lunar Planet. Sci. XXXIV*, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2008/pdf/1500.pdf>

Clegg S.M., Wiens R.C., Barefield J.E. II, Dyar M.D., Delaney J.S., Ashley G.M., and Driese S.G. (2008) Simulated ChemCam laboratory investigations of East African Rift sedimentary samples. *Lunar Planet. Sci. XXXIX*, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2008/pdf/2107.pdf>

Clegg S.M., Wiens R.C., Barefield J.E., Sklute E., and Dyar M.D. (2008) Quantitative Remote Laser Induced Breakdown Spectroscopy by Multivariate Analysis. *Spectrochimica Acta B.*, in preparation.

Saccoccio M., Maurice S., Wiens R., Barraclough B., Bernardin J., Cros A., Bender S., Clegg S., Parés L., Gasc K., Kouach D., Dubois B., Bouyé M., Thocaven J., Seran H., Parot Y., Orttner G., Faure B., Michel Y., Cais P., Berthé M., Pérez R., Stiglich R., Landis D., Hale T., Blaney D., Hayes C., Lindensmith C., Elliott T. (2008) The CHEMCAM instrument on Mars Science Laboratory (MSL 09): First laser-induced breakdown spectroscopy instrument in space! Mars and Beyond: 39th International Conference on Environmental Systems (ICES), Savannah, Georgia, July 12-16, 2009.

Tucker J., Dyar M.D., Schaefer M., Clegg S., Barefield J. II, Wiens R., Bishop J. (2008) Laser-induced breakdown spectroscopy of phyllosilicates for ChemCam calibration. Fall AGU, P53A-1429.

Dyar M.D., Tucker J.M., Clegg S.M., Barefield J.E., Wiens R.C. (2008) Quantitative sulfur analysis using stand-off laser-induced breakdown spectroscopy. Fall AGU.

Tucker J.M., Dyar M.D., Clegg S.M., Wiens R.C., and Barefield J.E. II (2008) Quantitative chemistry of phyllosilicate minerals using laser-induced breakdown spectroscopy. Phyllosilicates Workshop, Paris, France, October 21-23.

Dyar M., Schaefer M.W., Clegg S., Wiens R., Tucker J. (2008) Comparisons among calibration strategies for LIBS spectroscopy on Mars. *AAAS Division of Planetary Science Meeting, 40th, Ithaca, NY.*

Saccoccio M., Maurice S., Wiens R., Barraclough B., Bernardin J., Cros A., Bender S., Clegg S., Pares L., Gasc K., Kouach D., Dubois B., Bouyé M., Thocaven J., Seran H., Parot Y., Orttner G., Faure B., Michel Y., Cais P., Berthé M., Perez R., Stiglich R., Landis D., Hale T., Blaney D., Hayes C., Lindensmith C., Elliott T. (2008) ChemCam on MSL 2009: First laser-induced breakdown spectrometer for space science. International Conference on Space Optics, Toulouse, October 14-18, 2008.

Lentz R.C.F., Sharma S.K., Misra A.K., Clegg S.M., Wiens R.C., and Clark R. (2008) Laser-induced breakdown spectroscopy (LIBS) of phyllosilicates: Preparing for ChemCam on Mars. *Lunar Planet. Sci. XXXIX*, The Lunar and Planetary Institute, Houston, TX. <http://www.lpi.usra.edu/meetings/lpsc2008/pdf/2015.pdf>

Schaefer M.W., Dyar M.D., Clegg S.M., and Wiens R.C. (2008) An IDL routine for preprocessing and analysis of LIBS data. *Lunar Planet. Sci. XXXIX*, The Lunar and Planetary Institute, Houston, TX. <http://www.lpi.usra.edu/meetings/lpsc2008/pdf/2171.pdf>

Lanza N.L., Ollila A.M., Clegg S.M., Barefield J.E., Newsom H.E., and Wiens R.C. (2008) Identifying carbonate rocks in a Martian environment using LIBS. *Lunar Planet. Sci. XXXIX*, The Lunar and Planetary Institute, Houston, TX. <http://www.lpi.usra.edu/meetings/lpsc2008/pdf/2299.pdf>

Dyar M.D., Clegg S.M., Barefield J.E. II, Wiens R.C., Sklute E.C., and Schaefer M.W. (2008) Approaches to matrix-effect corrections in laser-induced breakdown spectroscopy of geologic samples. *Lunar Planet. Sci. XXXIX*, The Lunar and Planetary Institute, Houston, TX. <http://www.lpi.usra.edu/meetings/lpsc2008/pdf/2146.pdf>

Clegg S.M., Sklute E.C., Dyar M.D., Barefield J.E., and Wiens R.C. (2007) Quantitative analysis of samples with variable composition by remote laser-induced breakdown spectroscopy. 7th Int'l. Conference on Mars, July 9-13, Caltech, 3216. <http://www.lpi.usra.edu/meetings/7thmars2007/pdf/3216.pdf>

Clegg S.M., Wiens R.C., Dyar M.D., Vaniman D.T., Thompson J.R., Sklute E.C., Barefield J.E., Sallé B., Sirven J.-B., Mauchien P., Lacour J.-L., and Maurice S. (2007) Sulfur geochemical analysis with remote laser induced breakdown spectroscopy on the 2009 Mars Science Laboratory Rover. *Lunar Planet. Sci. XXXVIII*, 1960. <http://www.lpi.usra.edu/meetings/lpsc2007/pdf/1960.pdf>

Wiens R.C., Maurice S., Clegg S., Vaniman D., Thompson J., Dyar M.D., Sklute E., Newsom H., Lanza N., Sautter V., Dubessy J., Boiron M.C., Fabre C., Lacour J.-L., Sallé B., Mauchien P., Blaney D., Langevin Y., Herkenhoff K., Bridges N., and G., Manhes (2007) Preparation of onboard calibration targets for the ChemCam instruments on the Mars Science Laboratory rover. *Lunar Planet. Sci. XXXVIII*, 1180. <http://www.lpi.usra.edu/meetings/lpsc2007/pdf/1180.pdf>

Maurice S., Wiens R., Saccoccio M., Barraclough, Sallé B., Clegg S. and the ChemCam team (2007) Expected performances of the chemCam instrument for the Mars Science Laboratory (MSL) rover. *Lunar Planet. Sci. XXXVIII*, 1563. <http://www.lpi.usra.edu/meetings/lpsc2007/pdf/1563.pdf>

Sirven J.-B., Sallé B., Mauchien P., Lacour J.-L., Maurice S., Manhes G., Wiens R.C., Clegg S., and the ChemCam team (2007) Rocks identification at the surface of Mars by remote laser-induced breakdown spectroscopy and chemometrics. *Lunar Planet. Sci.* XXXVIII, 1565.

<http://www.lpi.usra.edu/meetings/lpsc2007/pdf/1565.pdf>

Sklute E.C., Dyar M.D., Clegg S.M., Wiens R.C., and Barefield J.E. (2007) Laser induced breakdown spectroscopy of samples with variable composition. *Lunar Planet. Sci.* XXXVIII, 1949.

<http://www.lpi.usra.edu/meetings/lpsc2007/pdf/1949.pdf>

Clegg S.M., Wiens R.C., Lawrence D.J., and Barefield J.E. (2007) Lunar elemental analysis with remote laser induced breakdown spectroscopy (LIBS). Lunar Science Workshop, Tempe, AZ, Feb. 27-28.

Clegg S.M., Wiens R.C., Sharma S.K., Lucey P., Misra A., and Barefield J. (2006) LIBS-Raman spectroscopy of minerals using remote surface modification techniques. *Lunar Planet. Sci.* XXXVII, 2069.

<http://www.lpi.usra.edu/meetings/lpsc2006/pdf/2069.pdf>

Thompson J., Wiens R.C., Clegg S.M., Barefield J.E., Vaniman D.T., and Newsom H.E. (2006) Remote laser-induced breakdown spectroscopy (LIBS) of DaG476 and Zagami Martian meteorites. *Lunar Planet. Sci.* XXXVII, Houston, Texas, March 13-17, 2006.

<http://www.lpi.usra.edu/meetings/lpsc2006/pdf/1761.pdf>

R.D. Harris, Cremers D.A., Khoo C., and Benelli K. (2005) LIBS-based detection of geological samples at low pressures (< 0.0001 Torr) for Moon and asteroid exploration. *Lunar Planet. Sci.* XXXVI, 1796, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1796.pdf>

Wiens R.C., Thompson J., Sharma S., Misra A., Barefield J., Clegg S., Steele S., Newsom H., Sallé B., and Maurice S., Remote LIBS analyses of Zagami and DAG 476 Martian meteorites. *Lunar Planet. Sci.* XXXVI, #2209, Houston, Texas, March 14-18, 2005.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/2209.pdf>

Clegg S.M., Thompson J.R., Wiens R.C., Barefield J.E., Vaniman D.T., and Newsom H.E. (2005) Remote laser induced breakdown spectroscopy (LIBS) of Martian meteorites and other basaltic samples. *EOS* (Fall AGU, San Francisco, December).

<http://www.lpi.usra.edu/meetings/lpsc2007/pdf/2074.pdf>

L.J. Radziemski, Cremers D.A., Benelli K., Khoo C., Harris R.D. (2005) LIBS-based detection of As, Br, C, Cl, P, and S in the VUV spectral region in a Mars atmosphere. *Lunar Planet. Sci.* XXXVI, 1747, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1747.pdf>

B. Sallé, Mauchien P., Lacour J.-L., Maurice S., and Wiens R.C. (2005) Laser-induced breakdown spectroscopy: a new method for stand-off quantitative analysis of samples on Mars. *Lunar Planet. Sci.* XXXVI, 1693, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1693.pdf>

Wiens R.C., Thompson J., Sharma S., Misra A., Barefield J., Clegg S., Steele S., Newsom H., Sallé B., and Maurice S., Remote LIBS analyses of Zagami and DAG 476 Martian meteorites. *Lunar Planet. Sci.* XXXVI, #2209, Houston, Texas, March 14-18, 2005.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/2209.pdf>

Wiens R., Maurice S., Bridges N., Clark B.C., Cremers D.A., Herkenhoff K.E., Kirkland L.E., Mangold N., Manhés G., Mauchien P., McKay C.P., Newsom H., Poitrasson F., Sautter V., d'Uston C., Vaniman D., Shipp S. (2005) ChemCam science objectives for the Mars Science Laboratory (MSL) rover. *Lunar Planet. Sci.* XXXVI, 1580, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1580.pdf>

Maurice S., Wiens R., Manhés G., Cremers D.A., Barraclough B.L., Bernardin J., Bouyé M., Cros A., Dubois B., Durand E., Hahn S., Kouach D., Lacour J.-L., Landis D., Moore T., Parés L., Platzer J., Saccoccio M., Sallé B., and Whitaker R. (2005) ChemCam instrument for the Mars Science Laboratory (MSL) rover. *Lunar Planet. Sci. XXXVI*, 1735, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1735.pdf>

Harris R.D., Cremers D.A., Khoo C., and Benelli K. (2005) LIBS-based detection of geological samples at low pressures (< 0.0001 Torr) for Moon and asteroid exploration. *Lunar Planet. Sci. XXXVI*, 1796, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1796.pdf>

Radziemski L.J., Cremers D.A., Benelli K., Khoo C., Harris R.D. (2005) LIBS-based detection of As, Br, C, Cl, P, and S in the VUV spectral region in a Mars atmosphere. *Lunar Planet. Sci. XXXVI*, 1747, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1747.pdf>

Sallé B., Mauchien P., Lacour J.-L., Maurice S., and Wiens R.C. (2005) Laser-induced breakdown spectroscopy: a new method for stand-off quantitative analysis of samples on Mars. *Lunar Planet. Sci. XXXVI*, 1693, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1693.pdf>

Cremers D., Sallé B., Wiens R., and Maurice S. (2004) Evaluation and development of compact spectrographs for stand-off LIBS analysis of geological samples from a Mars Rover. LIBS 2004 Conference, September 28- October 1, Malaga, Spain.

Sallé B., Cremers D., Maurice S., and Wiens R. (2004) LIBS analysis of geological samples at reduced pressures : Application to space missions. LIBS 2004 Conference, September 28- October 1, Malaga, Spain.

Wiens R.C., Kirkland L.E., McKay C.P., Cremers D.A., Thompson J., Maurice S., Pinet P.C. (2004) Analyses of IR-stealthy and coated surface materials: A comparison of LIBS and reflectance spectra and their application to Mars surface exploration. *Lunar Planet. Sci. XXXV*, 1695, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2004/pdf/1695.pdf>

Thompson J., Wiens R.C., Cremers D.A., Barefield J., Wetteland C. (2004) The suitability of laser-induced breakdown spectroscopy for determining the compositions of extraterrestrial materials. *Lunar Planet. Sci. XXXV*, 1912, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2004/pdf/1912.pdf>

Lacour J.L., Sallé B., Fichet P., Vors E., Fabre C., Dubessy J., Maurice S., Wiens R.C., and Cremers D.A. (2004) Rocks analysis at stand-off distance by LIBS in Martian conditions. *Lunar Planet. Sci. XXXV*, 1260, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2004/pdf/1260.pdf>

Sallé B., Cremers D.A., Benelli K., Busse J., Wiens R.C., and Maurice S. (2004) Evaluation of a compact spectrograph/detection system for a LIBS instrument. *Lunar Planet. Sci. XXXV*, 1263, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2004/pdf/1263.pdf>

Cremers D.A., Sevostiyanova E.V., Gibson L., and Wiens R.C. (2004) LIBS analysis of geological samples at low pressures: Application to Mars, the Moon, and asteroids. *Lunar Planet. Sci. XXXV*, 1589, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2004/pdf/1589.pdf>

Arp Z.A., Cremers D.A., and Wiens R.C. (2004) Preliminary study of laser-induced breakdown spectroscopy (LIBS) for a Venus mission. *Lunar Planet. Sci. XXXV*, 1338, The Lunar and Planetary Institute, Houston, TX..

<http://www.lpi.usra.edu/meetings/lpsc2004/pdf/1338.pdf>

Arp Z.A., Cremers D.A., and Wiens R.C. (2004) Application of laser induced breakdown spectroscopy (LIBS) to Mars polar exploration: LIBS analysis of water ice and water ice / soil mixtures. *Lunar Planet. Sci. XXXV*, 1932, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2004/pdf/1932.pdf>

Arp Z., Cremers D., Wiens R. (2003) Laser-induced breakdown spectroscopy (LIBS) for the analysis of water ice and water ice/soil mixtures. *EOS*.

Cremers D.A., Wiens R.C., Arp Z.A., Harris R.D., and Maurice S. (2003) Development and testing of laser-induced breakdown spectroscopy for the Mars rover program: Elemental analysis at stand-off distances. *Sixth International Conference on Mars*, 3107, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/sixthmars2003/pdf/3107.pdf>

Swindle T.D., Bode R., Boynton W.V., Kring D.A., Chutjian A., Darrach M.R., Cremers D.A., Wiens R.C., and Baldwin S.L. (2003) AGE (Argon Geochronology Experiment): An instrument for in situ geochronology on the surface of Mars. *Lunar Planet. Sci. XXXIV*, 1488, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2003/pdf/1488.pdf>

Wiens R.C., Chevrel S., Cremers D.A., and Maurice S. (2003) The applicability of laser-induced breakdown spectroscopy (LIBS) to Mars exploration. *Lunar Planet. Sci. XXXIV*, 1646, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2003/pdf/1646.pdf>

Cremers D.A., Brown K., Gibson L., Ferris M.J., Wiens R.C., Maurice S., and Salle B. (2003) Analysis of water ice and ice/dust mixtures using laser-induced breakdown spectroscopy (LIBS). *Lunar Planet. Sci. XXXIV*, 1715, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2003/pdf/1715.pdf>

Lacour J.L., Salle B., Brennetot R., Vors E., Fichet P., Rivoallan A., Fabre C., Dubessy J., Maurice S., Wiens R.C., and Cremers D.A. (2003) Laser induced breakdown spectroscopy under Martian conditions: Optimization of operating conditions. *Lunar Planet. Sci. XXXIV*, 1582, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2003/pdf/1582.pdf>

Salle B., Vors E., Lacour J.L., Rivoallan A., Fichet P., Fabre C., Dubessy J., Maurice S., Wiens R.C., and Cremers D.A. (2003) Laser induced breakdown spectroscopy on Mars: Elemental composition study at different distances. *Lunar Planet. Sci. XXXIV*, 1578, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2003/pdf/1578.pdf>

Cremers D.A., Arp Z., Knight A.K., Scherbarth N.L., Wiens R.C., Maurice S., and Salle B. (2003) Characteristics of stand-off detection of geological samples at Mars atmosphere pressure using laser-induced breakdown spectroscopy (LIBS). *Lunar Planet. Sci. XXXIV*, 1654, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2003/pdf/1654.pdf>

Cremers D.A., Wiens R.C., Ferris M.J., and Blacic J.D. (2002) Development and testing of a prototype LIBS instrument for a NASA Mars rover. LIBS 2002 Conference, Orlando, FL.

Cremers D.A., Wiens R.C., Ferris M.J., Brennetot R., and Maurice S. (2002) Capabilities of LIBS for analysis of geological samples at stand-off distances. LIBS 2002 Conference, Orlando, FL.

Fabre C., Brennetot R., Fichet P., Vors E., Lacour J.L., Dubessy J., Boiron M-C., Rivoalan A., Maurice S., Cremers D., and Wiens R. (2002) A LIBS spectral database obtained in Martian conditions with an echelle spectrometer for in-situ analysis of Mars soils and rocks. LIBS 2002 Conference, Orlando, FL.

Brennetot R, Vors E., Lacour J.L., Fichet P., Fabre C., Dubessy J., Rivoallan A., Maurice S., Wiens R.C., and Cremers D.A. (2002) LIBS for in situ analysis of Mars soils and rocks: Spectral database of major elements Si, Al, Fe, Ti contained in rock samples. *Lunar Planet. Sci. XXXIII*, 1178.
<http://www.lpi.usra.edu/meetings/lpsc2002/pdf/1178.pdf>

Wiens R.C., Arvidson R.E., Blacic J.D., Chevrel S., Cremers D.A., Brennetot R., Maurice S., and Newsom H. (2002) Critical issues in martian geochemistry involving minor and trace elements, and the applicability of laser-induced breakdown spectroscopy (LIBS). *Lunar Planet. Sci. XXXIII*, 1348.
<http://www.lpi.usra.edu/meetings/lpsc2002/pdf/1348.pdf>

Cremers D.A., Wiens R.C., Ferris M.J., Blacic J.D., Brennetot R., and Maurice S. (2002) Development of laser-induced breakdown spectroscopy (LIBS) for analysis of geological samples on planetary missions. *Lunar Planet. Sci. XXXIII*, 1330.
<http://www.lpi.usra.edu/meetings/lpsc2002/pdf/1330.pdf>

Wiens R.C., Cremers D.A., Ferris M., Arvidson R.E., Seelos F.P. IV, Blacic J.D., and Nordholt J.E. (2001) Elemental compositions at stand-off distances from a rover: Development and testing of a laser-induced breakdown spectroscopy (LIBS) field prototype instrument. *Lunar Planet. Sci. XXXII*, 1339, The Lunar & Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/lpsc2001/pdf/1339.pdf>

Wiens R.C., Cremers D.A., Ferris M., and Blacic J.D. (2000) Rapid elemental analysis at stand-off distances using the LIBS concept from the Mars Instrument Development Program. In *Concepts and Approaches for Mars Exploration*, pp. 310-311, LPI Contribution 1062, Lunar and Planetary Institute, Houston.
<http://www.lpi.usra.edu/meetings/robomars/pdf/6077.pdf>

Seelos F.P., Wiens R.C., Cremers D.A., Ferris M., Blacic J.D., and Arvidson R.E. (2000) Combined remote mineralogical and elemental measurements from rovers. In *Concepts and Approaches for Mars Exploration*, pp. 279-280, LPI Contribution 1062, Lunar and Planetary Institute, Houston.
<http://www.lpi.usra.edu/meetings/robomars/pdf/6189.pdf>

Wiens R.C., Cremers D.A., Ferris M., Nordholt J.E., Blacic J.D., Lucey P., and Sharma S.K. (2000) Development of a prototype laser-induced breakdown spectroscopy (LIBS) instrument with stand-off Raman capabilities as part of the Mars Instrument Development Program. *Lunar Planet. Sci. XXXI*, 1468, The Lunar and Planetary Institute, Houston.
<http://www.lpi.usra.edu/meetings/LPSC2000/pdf/1468.pdf>

Knight A.K., Cremers D.A., Ferris M.J., Scherbarth N.L., Wiens R.C., Blacic J.D., Calvin W.M., and Nordholt J.E. (1999) Development of a prototype instrument for stand-off elemental analysis for use on a Mars rover. *5th Int'l. Conf. On Mars*, 6064, The Lunar & Planetary Science Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/5thMars99/pdf/6064.pdf>

Knight A.K., Scherbarth N.L., Cremers D.A., Ferris M.J., Wiens R.C., Blacic J.D., and Nordholt J.E. (1999) Development of a prototype instrument for the Mars rover program: quantitative elemental analyses at stand-off distances, *Lunar Planet Sci. XXX*, 1018, The Lunar and Planetary Institute, Houston, TX.
<http://www.lpi.usra.edu/meetings/LPSC99/pdf/1018.pdf>

Wiens R.C., Cremers D.A., Blacic J.D., Ritzau S.M., Funsten H.O., and Nordholt J.E. (1998) Elemental and isotopic planetary surface analysis at stand-off distances using laser-induced breakdown spectroscopy

and laser-induced plasma ion mass spectrometry. Abstract #1633. *Lunar Planet. Sci. XXIX*, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/LPSC98/pdf/1633.pdf>

Kane, K.Y. and Cremers D.A. (1992) Remote Elemental Analysis of Planetary Surfaces Using Laser-Induced Breakdown Spectroscopy, *Lunar Planet. Sci. XXIII*, 651-652, The Lunar and Planetary Institute, Houston, TX.

Remote Raman Spectroscopy Publications

Sharma S.K., Misra A.K., Clegg S.M., Barefield J.E., Wiens R.C., and Acosta T. (2010) Time-resolved remote-Raman spectroscopic study of minerals at high temperatures and under supercritical CO₂ relevant to Venus exploration. *Phil. Trans. Roy. Soc. A* 368, 3167-3191.

Sharma, S. K. (2007) New trends in telescopic remote Raman spectroscopic instrumentation, *Spectrochim. Acta A* 68, 1036-1045.

Sharma, S. K., A. K. Misra, P. G. Lucey, R. C.F. Lentz, and C. H. Chio (2007) Stand-off Raman Instrument for Detection of Bulk Organic and Inorganic Compounds, *SPIE Proc.* 6554, 6554-04 (in press).

Chio, C. H., Shiv K. Sharma, and David W. Muenow (2007) The hydrates and deuterates of ferrous sulfate (FeSO₄): a Raman spectroscopic study, *J. Raman Spectrosc.* 38, 87-99.

Stopar, J. D. Paul G. Lucey, Shiv K. Sharma, Anupam K. Misra, G. Jeffrey Taylor, Hugh W. Hubble (2005) Raman efficiencies of natural rocks and minerals: Performance of a remote Raman system for planetary exploration at a distance of 10 meters, *Spectrochim Acta A*, 61, 2315-2323.

Sharma, S. K. Anupam. K. Misra, and Bhavna Sharma (2005) Portable remote Raman system for monitoring hydrocarbon, gas hydrates and explosives in the environment, *Spectrochim Acta A* 61, 2404-2412.

Misra, A. K. Shiv K. Sharma, Chi Hong Chio, Paul G. Lucey, and Barry Lienert (2005) Pulsed remote Raman system for daytime measurements of mineral spectra, *Spectrochim Acta A* 61, 2281-2287.

Chio, C. H., Shiv K. Sharma, and David W. Muenow (2005) Micro-Raman studies of hydrous ferrous sulfates and jarosites, *Spectrochim Acta A* 61, 2428-2433.

Carter, J. Jon Scaffidi, Shana Burnett, Brian Vasser, Shiv K. Sharma, S. Michael Angel (2005) Stand-off Raman detection using dispersive and tunable filter based systems, *Spectrochim Acta A* 61, 2288-2298.

Bozlee, B. J., Anupam K. Misra, Shiv K. Sharma, and Melissa Ingram (2005) Remote Raman and fluorescence studies of mineral samples, *Spectrochim Acta A* 61, 2342-2348.

Sharma, S. K., S. Ismail, S. M. Angel, P. G. Lucy, C. P. McKay, A. K. Misra, P. J. Mougini-Mark, H. Newsom, U. N. Singh, and G. J. Taylor (2004) Remote Raman and Laser-induced Fluorescence (RLIF) emission instrument for detection of Minerals, organic and biogenic materials on Mars to 100 meters radial distance, *Proc. SPIE*, 5660, 128-138.

Chio, C. H., S. K. Sharma, and D. W. Muenow (2004) Raman spectroscopic studies of gypsum between 33 and 374 K, *American Mineral*, 89, 390-395.

Stopar, Julie D., Paul G. Lucey, Shiv K. Sharma, Anupam K. Misra, Hugh W. Hubble (2004) A remote Raman system for planetary exploration: evaluating remote Raman efficiency (Invited Paper), Proc. SPIE, Vol. 5163, 99-110 (2004)

Sharma S.K., Lucey P.G., Ghosh M., Hubble H.W., and Horton K.A. (2003) Stand-off Raman spectroscopic detection of minerals on planetary surfaces. *Spectrochim. Acta A59*, 2391-2407.

Sharma S.K., Angel M.S., Ghosh M., Hubble H.W., and Lucey P.G. (2002) A remote, pulsed-laser Raman spectroscopy system for mineral analysis on planetary surfaces. *Applied Spectroscopy*, 56, 699-705.

Remote Raman Spectroscopy Abstracts

Sharma S.K., Misra A.K., Clegg S.M., Barefield J.E., and Wiens R.C. (2009) Time-resolved remote-Raman spectroscopic study of minerals at high temperature and under supercritical CO₂ relevant to Venus exploration. Fall AGU.

Clegg S.M., Sklute E.C., Dyar M.D., Barefield J.E., and Wiens R.C. (2007) Quantitative analysis of samples with variable composition by remote laser-induced breakdown spectroscopy. *7th Int'l. Conference on Mars*, July 9-13, Caltech, 3216.

<http://www.lpi.usra.edu/meetings/7thmars2007/pdf/3216.pdf>

Sharma S.K., Misra A. K. and Lucey, P. G. (2007) Stand-off Raman instrument for detection of bulk organic and inorganic compounds, SPIE's Defense and Security Symposium 2007, Conference 6554, 9-13 April 2007, Orlando, Florida.

Sharma S.K. (2006) New trends in telescopic and confocal micro-Raman spectroscopic instrumentation (Invited Paper) *GEORAMAN-2006: 7th Int. Conf. On Raman spectroscopy Applied to the Earth and Planetary Sciences*, June 5-7, 2006, Granada, Spain.

Sharma S.K., Alian Wang and Larry A. Haskin, Remote Raman measurements of minerals with Mars microbeam Raman spectrometer (MMRS), *Lunar and Planetary Sci. Conference*, XXXVI, #1524, Houston, Texas, March 14-18, 2005b.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1524.pdf>

Misra A.K., Sharma S.K., and Lucey P.G. (2005) Single pulse remote Raman detection of minerals and organics under illuminated conditions from 10 meters distance. *Lunar Planet. Sci. XXXVI*, 1546, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1546.pdf>

Sharma S.K., Wang A., and Haskin L.A.. (2005) Remote raman measurements of minerals with Mars Microbeam Raman Spectrometer (MMRS). *Lunar Planet. Sci. XXXIV*, 1524, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1524.pdf>

Sharma S.K., S. Ismail, M. S. Angel, P. G. Lucey, C. P. McKay, P. J. Mouginis-Mark, H. Newsom, U. N. Singh, NASA, and J. G. Taylor (2004) "Remote Raman and laser-induced fluorescence emission instrument for the detection of mineral, organic and biogenic materials on Mars to 100 meters radial distance" presented at the Planetary Instruments II session of the "Instruments, Science, and Methods for Geospace and Planetary Remote Sensing", Conference # 5660, , *SPIE Fourth International Asia-Pacific Environmental Remote Sensing Symposium*, Waikiki Beach Marriott Resort, Honolulu, Hawaii USA, 8-11 November 2004.

Misra A.K., S. K. Sharma, C. H. Chio, P. G. Lucey, and B. Lienert (2004) Pulsed Remote Raman System for Daytime Measurements of Mineral Spectra, presented at the *GEORAMAN 2004: 6th Int. Conf. On Raman spectroscopy Applied to the Earth and Planetary Sciences*, Honolulu, Hawaii, USA. June 6-11, 2004.

Chio C.H., S. K. Sharma, and D. W. Muenow (2004) Micro-Raman Studies of Hydrous Ferrous Sulfates, and Jarosites, presented at the *GEORAMAN 2004: 6th Int. Conf. On Raman spectroscopy Applied to the Earth and Planetary Sciences*, Honolulu, Hawaii, USA. June 6-11, 2004.

Singh U.N., F. Hovis, S. K. Sharma, and S. Ismail (2004) Miniature Laser for Remote Raman and Fluorescence Spectroscopy of Martian Surface, presented at the *GEORAMAN 2004: 6th Int. Conf. On Raman spectroscopy Applied to the Earth and Planetary Sciences*, Honolulu, Hawaii, USA. June 6-11, 2004. (Invited)

Angel S.M., S. Burnett, J. Scaffidi, S. K. Sharma, and J. C. Carter (2004) Standoff Raman Measurements using Fiber-coupled Dispersive and Tunable Filter Spectrometers: A Discussion of Techniques and Experimental Issues, presented at the *GEORAMAN 2004: 6th Int. Conf. On Raman spectroscopy Applied to the Earth and Planetary Sciences*, Honolulu, Hawaii, USA. June 6-11, 2004. (Invited)

Sharma S.K., A. K. Misra, B. Sharma (2004) Portable Remote Raman System for Monitoring Hydrocarbon in the Environment, presented at the *GEORAMAN 2004: 6th Int. Conf. On Raman spectroscopy Applied to the Earth and Planetary Sciences*, Honolulu, Hawaii, USA. June 6-11, 2004. (Invited)

Stopar J.D., P. G. Lucey, S. K.Sharma, A. K. Misra, G. J. Taylor, and H. W. Hubble (2004) Efficiency of a Remote Raman System for Planetary Exploration, presented at the *GEORAMAN 2004: 6th Int. Conf. On Raman spectroscopy Applied to the Earth and Planetary Sciences*, Honolulu, Hawaii, USA. June 6-11, 2004.

Stopar, J. D., P. G. Lucey, S. K. Sharma, H. W. Hubble, and A. K. Misra (2003) Performance of a remote Raman system: defining remote Raman efficiency. *Lunar and Planetary Science XXXIV* (2003), abstract # 1450. <http://www.lpi.usra.edu/meetings/lpsc2003/pdf/1450.pdf>

Sharma S.K., Beall G.H., Hubble H.W., Misra A.K., Chio C.H., and Lucey P.G. (2003) Telescopic Raman measurements of glasses of mineral compositions to a distance of 10 meters. *Lunar Planet. Sci. XXXIV*, 1915, The Lunar and Planetary Institute, Houston, TX. <http://www.lpi.usra.edu/meetings/lpsc2003/pdf/1915.pdf>

Sharma, S. K. J. N. Porter, A. K. Misra, H. W. Hubble, and P. Menon (2003) Portable standoff Raman and Mie-Rayleigh lidar for cloud, aerosol, and chemical sensing, *Lidar Remote Sensing for Environmental Monitoring IV*, SPIE conference #5154, August 3-4, 2003, San Diego, CA.

Lucey, P. G., J. Stopar and S. Sharma (2003) Remote Raman system for standoff analysis of planetary surfaces (*Invited Paper*), *Instruments, Methods, and Missions for Astrobiology VII, SPIE Conference 5163*, August 3-4, 2003, San Diego, CA.

Hubble H.W., Ghosh M., Sharma S.K., Horton K.A., Lucey P.G., Angel S.M., and Wiens R.C. (2002) A combined remote LIBS and Raman spectroscopic study of minerals. *Lunar Planet. Sci. XXXIII*, 1935. <http://www.lpi.usra.edu/meetings/lpsc2002/pdf/1935.pdf>

Horton K.A., Sharma S.K., Domergue-Schmidt N., and Lucey P.G. (2001) A remote Raman analysis system for planetary landers. *Lunar Planet. Sci. XXXII*, 1462, The Lunar and Planetary Institute, Houston, TX. <http://www.lpi.usra.edu/meetings/lpsc2001/pdf/1462.pdf>

Lucey P.G., Cooney T.F., and Sharma S.K. (1998) A remote Raman analysis system for planetary landers. *Lunar Planet. Sci. XXIX*, 1354, The Lunar and Planetary Institute, Houston. <http://www.lpi.usra.edu/meetings/LPSC98/pdf/1354.pdf>

Combined LIBS and Raman Spectroscopy Publications

Sharma S.K., Misra A.K., Lucey P.G., Wiens R.C., and Clegg S.M. (2007) Combined Remote LIBS and Raman Spectroscopy of Sulfur-Containing Minerals, and Minerals Coated with Hematite and Covered with Basaltic Dust at 8.6 m. *Spectrochim. Acta A* (in press).

Wiens, R.C., Shiv K. Sharma, Justin Thompson, Anupam Misra, Paul G. Lucey (2005) Joint analyses by laser-induced breakdown spectroscopy (LIBS) and Raman spectroscopy at stand-off distances, *Spectrochim Acta A* 61, 2324-2334.

Combined LIBS and Raman Spectroscopy Abstracts

Wiens R.C., Clegg S., Sharma S., Maurice S., Dyar M.D. (2010) Proposed remote Raman-LIBS geochemical exploration on the surface of Venus. LIBS 2010, Sept. 13-17, Memphis, TN.

Lambert J., Morookian J., Roberts T., Polk J., Smrekar S., Clegg S.M., Wiens R.C., Dyar M.D., Treiman A. (2010) Standoff LIBS and Raman spectroscopy under Venus conditions. *Lunar Planet. Sci. XLI*, 2608.

<http://www.lpi.usra.edu/meetings/lpsc2010/pdf/2608.pdf>

Sharma S.K., Clegg S.M., Misra A.K., Barefield J.E., Wiens R.C., Quick C.R., Dyar M.D., McCanta M.C., and Elkins-Tanton L. (2009) Venus geochemical analysis by remote Raman – Laser Induced Breakdown Spectroscopy (Raman-LIBS). Abstract #2548, *Lunar Planet. Sci. XL*, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2009/pdf/2548.pdf>

Clegg S.M., Barefield J.E., Wiens R.C., Quick C.R., Sharma S.K., Misra A.K., Dyar M.D., McCanta M.C., and Elkins-Tanton L. (2009) Venus geochemical analysis by remote Raman – Laser Induced Breakdown Spectroscopy (Raman-LIBS). Abstract 2013. *Venus Geochemistry: Progress, Prospects, and New Missions*, February 26-27, 2009, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/venus2009/pdf/2013.pdf>

Clegg S.M., Wiens R.C., Bender S., Maurice S., Sharma S., Misra A. et al. (2008) Remote Raman-LIBS geochemical investigation under Venus atmospheric conditions. Fall AGU.

Wiens R.C., Sharma S.K., Clegg S.M., Misra A.K., and Lucey P.G. (2007) Combined remote Raman spectroscopy and LIBS instrumentation for Mars astrobiology exploration. 7th Int'l. Conference on Mars, July 9-13, Caltech, 3092.

<http://www.lpi.usra.edu/meetings/7thmars2007/pdf/sess11.pdf>

Sharma S.K., Misra A.K., Lucey P.G., Wiens R.C., and Clegg S.M. (2007) Combined remote LIBS and Raman spectroscopy of minerals using a single laser source. *Lunar Planet Sci. XXXVIII*, #1208, Houston, Texas.

<http://www.lpi.usra.edu/meetings/lpsc2007/pdf/1208.pdf>

Clegg S.M., Wiens R.C., Sharma S.K., Lucey P., Misra A., and Barefield J., LIBS-Raman spectroscopy of minerals using remote surface modification techniques. *Lunar Planet. Sci. XXXVII*, #2069, Houston, Texas, March 13-17, 2006.

<http://www.lpi.usra.edu/meetings/lpsc2006/pdf/2069.pdf>

Sharma S.K., Misra, A. K., Lucey, P. G., Wiens, R.C. and Clegg S.M. (2006) Combined remote LIBS and Raman spectroscopy of minerals coated with hematite and covered with basaltic dust At 8.6 m, *GEORAMAN-2006: 7th Int. Conf. On Raman spectroscopy Applied to the Earth and Planetary Sciences*, June 5-7, 2006, Granada, Spain.

Thompson J., Wiens R.C., Sharma S.K., Lucey P.G., and Misra A. (2005) Combined remote LIBS and Raman spectroscopy measurements. *Lunar Planet. Sci. XXXVI*, 1517, The Lunar and Planetary Institute, Houston, TX.

<http://www.lpi.usra.edu/meetings/lpsc2005/pdf/1517.pdf>

Wiens R.C., S. K. Sharma, D. A. Cremers, and P. G. Lucey (2004) Combined Instrumentation for Remote Raman Spectroscopy and Laser-Induced Breakdown Spectroscopy (LIBS), presented at the *GEORAMAN 2004: 6th Int. Conf. On Raman spectroscopy Applied to the Earth and Planetary Sciences*, Honolulu, Hawaii, USA. June 6-11, 2004. (Invited)

Wiens R.C., Cremers D.A., Ferris M., Nordholt J.E., Blacic J.D., Lucey P., and Sharma S.K. (2000) Development of a prototype laser-induced breakdown spectroscopy (LIBS) instrument with stand-off Raman capabilities as part of the Mars Instrument Development Program. *Lunar Planet. Sci. XXXI*, 1468, The Lunar and Planetary Institute, Houston.

<http://www.lpi.usra.edu/meetings/LPSC2000/pdf/1468.pdf>