EPSC Abstracts,
Vol. 4, EPSC2009-803, 2009
European Planetary Science Congress,

The preparation of metal-coated mineral micro-particles for use in hypervelocity impact experiments

J. K. Hillier (1), S. Sestak (1,2), S. F. Green (1), F. Postberg (3,4), R. Srama (4), M. Trieloff (3)

(1) PSSRI, The Open University, Walton Hall, Milton Keynes, MK7 6AA, U.K., j.k.hillier@open.ac.uk (2) CSIRO, Petroleum Resources, PO Box 136, North Ryde, Sydney, NSW 1670, Australia (3) Institut für Geowissenschaften, Universität Heidelberg, Germany (4) Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Abstract

Laboratory hypervelocity impact experiments often rely on the use of Van de Graaff accelerators to achieve high particle speeds. Whilst this is feasible for conductive projectiles (e.g. metals, some oxides, graphite), non-conductive materials (e.g. minerals, some oxides, some organics) cannot be charged and electrostatically accelerated without prior processing.

Recent developments have enabled insulating materials to be reliably coated with a conductive layer – either an organic polypyrrole (e.g. [1]) or a metal [2] – and charged and accelerated in a Van de Graaff accelerator.

The metal coating process, based on methods discussed by Lee et al. [3] and Chen et al. [4], can coat materials with surface sites resembling those of silicates or some oxides (OH teminated surface groups). Through treatment with mercaptopropyl trimethoxysilane (MPTMS) the particles are functionalised, gaining a reactive surface monolayer of MPTMS that actively binds to (amongst others) platinum group metals. This then allows an extremely thin layer of metal to be deposited on the particles.

For materials that do not have the required surface chemistry for MPTMS functionalisation, a second stage of processing is performed, in which a thin (<10-40 nm) layer of silica is first deposited on the particles' surfaces via a sol-gel method [5]. This surface is then treated with MPTMS and a metal layer then added.

The complete methods and latest results of the functionalisation and coating process will be presented, showing how a wide variety of silicates, oxides, sulphides, hydrated minerals and carbides have been successfully coated and electrostatically accelerated.

References

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