CARBON RAMAN SPECTROSCOPY: NATURAL AND EXPERIMENTALLY-INDUCED VARIATIONS IN IDPS.

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Introduction: Carbon Raman spectroscopy has been shown to complement other techniques in identifying levels of thermal alteration in meteorites. As it has high spatial resolution and is relatively non-destructive, it can also be applied to micron-sized IDPs. Many IDPs are thought to originate from comets rather than asteroids [1], and so are expected to show lesser degrees of parent body thermal alteration than meteorites. Indeed, the majority of IDPs contain organic matter (OM) that is similar to or more disordered than the most primitive insoluble organic matter (IOM) separated from meteorites [2, 3]. In particular, some of the IDPs collected to coincide with the passing though comet Grigg-Skjellerup's dust stream (GSC) show Raman characteristics which are among the most primitive to date, complementing NanoSIMS isotope data on H and N which conclude the same [4]. However, average parameters for GSC-IDPs, normal IDPs and the most unaltered IOM are similar, suggesting asteroids and comets acquired their OM from a common reservoir.

We have applied this technique to 27 IDPs to determine the degree of order of their OM, and identify the most primitive and C-rich particles for a detailed NanoSIMS study. Fragments of these IDPs have also been analysed with FTIR spectroscopy [5]. Ultimately they will be examined in RELAX, a time of flight mass analyzer for Xe [6]. The samples are cluster particles of varying textures and compositions from 8 different collections.

Method: We used a Renishaw inVia Raman microscope with a 514 nm laser, based at Manchester Metropolitan University to determine D and G band widths Γ and positions ω. Meteoritic IOM separates from several meteorite types were used as standards. The IDPs were unpressed and positioned on gold foil covered SEM stubs. The laser was focused using x50 magnification. The spot size was ~ 2 µm and the laser power was kept <30 µW.

Results: Of the 20 IDPs yielding Raman parameters with low errors, all but three plot alongside the most primitive IOM (EET 92042, Semarkona, Murchison), agreeing with other studies that show IDPs have the most disordered C, and therefore least thermal alteration, adding to the likelihood that they are cometary material. The OM of the GSC particle is the most amorphous from the G band data, possibly indicative of irradiation in space.

Our data is comparable with literature trends (taken with 532 nm excitation [2]) if shifts in D and to a much lesser extent G band are accounted for. These shifts can be explained by (i) different laser excitation, whereby D and G ω decrease with increasing excitation wavelength [7]. (ii) Shifts due to laser power, whereby we observe differences of up to 100 cm^{-1} in D band width between 25 and 125 µW for most disordered IOM. Given the smaller beam in the previous study [2], the power density they used was significantly greater than 125 µW. Adjusted accordingly, trends for IDPs and IOM agree with previous studies.

Acknowledgements: We thank V. Vishnyakov at the MMU DRIAM facility funded by EPSRC grant EP/F056117/1.

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