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Scattering from graphite, expanded graphite, graphene and graphene oxide particles and particulate layers

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Carbonaceous particles (amorphous carbon, graphite, carbonates, nanodiamonds *etc*.) of highly irregular shapes are one of the major constituents of the interstellar dust and regolith layers. Depending on their origin they can be compact or fluffy aggregates of submicron to micron sized grains with large values of real and imaginary part of the refractive index and can be sometimes embedded in an absorbing mantle or in the form of composite grains. The proper study and analysis of light scattered by interstellar dust particles is very important as such results help in remote detection and retrieval of information about their physical properties. In this context laboratory research on the properties of terrestrial interstellar dust analogues are of great astronomical importance as their properties are found to be similar to the properties of planetary regolith, cometary dust *etc* [1].

We have chosen graphite as the original sample for our investigations since graphite can transform to expanded graphite, graphene and graphene oxide at suitable environmental conditions (e.g. chemical, thermal, *etc*.) with abrupt changes in their optical, electrochemical and mechanical properties. The knowledge of the scattering properties of graphite, expanded graphite, graphene and graphene oxide particles and particulate layers is essential for deducing their physical and optical properties, which in turn may give clues for understanding earlier events like formation of comets, planets, *etc*.

In this contribution, we report the light scattering properties of graphite, expanded graphite, graphene and graphene oxide particles and particulate layers as a function of scattering angle at 543, 594 and 632 nm incident laser wavelengths, measured by using a laboratory light scattering setup. The setup can measure scattered light signals from 10° to 170° in steps of 1°. The experimental errors were reduced by taking the average of a large number of scattering measurements on the same set of samples. A comparison of the experimental results with theoretical calculations was also conducted to interpret the experimentally observed light scattering patterns.

Reference

1. Volten, H., et al. *J. Geophys. Res.*, 106 (D15), 17375–17401, 2001.