Carbon nanoparticles as cosmic dust analogues

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Cosmic dust is formed in the circumstellar environments of dying stars. In these particular regions of the universe, the accretion from the gaseous phase produces small clusters and nanoparticles which are then ejected to the interstellar medium where energetic processing takes place. In this sense, the fabrication and processing of nanoparticles in the laboratory, at conditions resembling those at the atmosphere of dying stars, constitutes an invaluable tool to understand the chemical complexity in space. To this purpose, we have designed and built a novel ultra-high vacuum machine to simulate in the laboratory the formation of cosmic dust [1].

We have fabricated carbon nanoparticles in the gas phase from carbon atoms and molecular hydrogen using gas aggregation sources. The obtained small carbon clusters and nanoparticles are aliphatic in nature and present a low degree of hydrogenation. Our results suggest that the observed aromatic species in space are not efficiently formed in the circumstellar environments of dying stars but after the processing of the carbon clusters on the surface of cosmic dust grains [2]. These results open new possibilities for interpreting the chemical routes leading to chemical complexity in space and stablish accurate and controlled laboratory simulation experiments as powerful methods for astrophysics.

References

[1] L. Martínez, K. Lauwaet, G. Santoro *et al.*, Sci. Rep. 8 (2018) 7250
[2] L. Martínez, G. Santoro, P. Merino *et al.*, (submitted to Nature Astronomy)

Figures

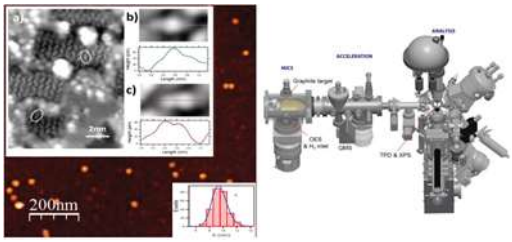

Figure 1: Left: STM and AFM images of C-nanograins and C-clusters collected on a surface. Right: technical drawing of the "Stardust" configuration used in the experiments.