

ION IRRADIATION AND THE COLORS OF TNOs. R. Brunetto^{1,2}, and G. Strazzulla¹, ¹INAF-Osservatorio Astrofisico di Catania, Italy, ²Institut d'Astrophysique Spatiale, CNRS, University of Paris-Sud, Orsay, France

Solar wind and cosmic ion irradiation affects the surface properties of airless bodies. Effects such as chemical and structural modifications have been investigated in the laboratory, as well as the induced changes in the spectral slope of frozen gases. Visible and near-infrared reflectance spectra of trans-Neptunian objects and Centaurs revealed a great variety of colors that are believed to be the result of a competition between aging (e.g., cosmic ion irradiation) and rejuvenating (e.g., impacts with space debris, cryovolcanism, etc.) processes [1,2].

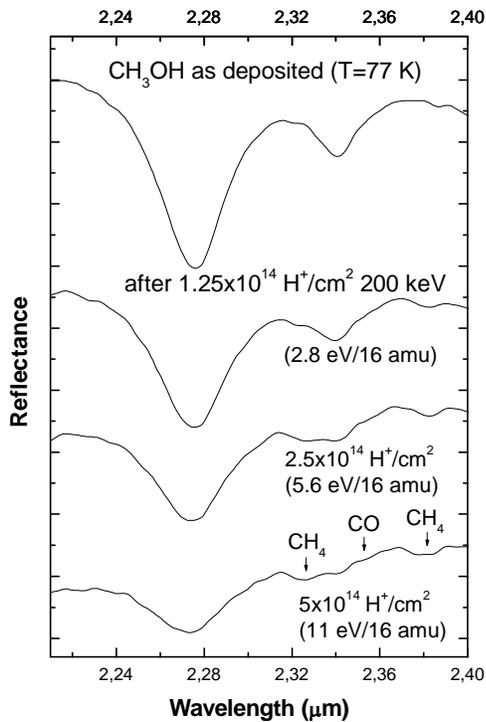


Figure 1: Reflectance spectra (2.2-2.4 μm) showing the formation of CH₄ and CO after irradiation of frozen (77K) methanol with 200 keV protons.

Here we present the results of ion irradiation experiments performed by irradiating frozen C-rich targets with 100's keV H and Ar ions. We evidence the formation of new molecular species. An example is given in Figure 1 that shows the formation of CH₄ and CO after 200 keV H⁺ irradiation of frozen methanol [3].

Irradiation of frozen (16–80 K) methanol (CH₃OH), methane (CH₄), and benzene (C₆H₆), with

200 keV H⁺ and Ar⁺ ions, and 400 keV Ar⁺⁺ ions, up to a dose released to target molecule of about 350 eV per 16 amu, evidences a strong reddening and darkening of the spectra (see e.g. Figure 2), due to the formation of an organic (C-rich) refractory residue [4].

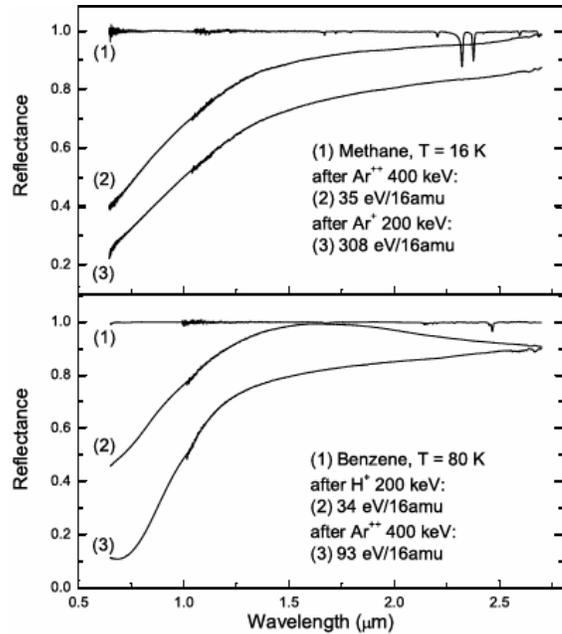


Figure 2. Absolute reflectance of as-deposited and ion irradiated methane at 16 K, and benzene at 80 K.

The laboratory spectra are compared with the spectra of some Centaurs and TNOs: we find that the colors of many icy objects in the outer Solar System are reproduced by laboratory spectra. Those objects could have grown an irradiation mantle.

References:

- [1] Doressoundiram A. et al. (2002) AJ 124, 2279-2296.
- [2] Peixinho N. et al. (2004) Icarus, 170, 153-166.
- [3] Brunetto R. et al. (2005) Icarus 175, 226-232.
- [4] Brunetto R. et al. (2006) ApJ, 644, 646-650.