Residue from VUV irradiation of benzene ices

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Benzene (C_6H_6) is the basic aromatic molecule of the interstellar medium and the basis of all the polycyclic aromatic hydrocarbon (PAH) and the caged carbon molecules, such as C_{60} and C_{70}. The discovery of benzene in the interstellar medium was a big support in the discussion on PAH molecules being the carriers of unknown bands. Many laboratory experiments focused on the dissociation and formation of complex organics from benzene, as pure and in a mixture of ices [1, 2, & 3]. The most intense infrared band of benzene was found to grow in intensity when benzene ice was irradiated with the 3 keV He ions, which was due to the synthesis of an aromatic residue [2]. The ion irradiated benzene ices have been compared with the observational data of TNOs to explore the materials on the surface of these bodies [4]. Recently ([3] and references therein), in a mixture of ices containing benzene and carbon dioxide, such an aromatic residue was reported upon irradiating the mixed ices. Therefore, the aromatic residue from benzene irradiation has a significant role to play in the ISM. However, to-date the structure of the residue resulting from benzene ice irradiation is least explored. We had subjected benzene ices that are formed at 4 K on a cold dust analog (LiF window) to vacuum ultraviolet (9 eV) irradiation. Irradiation was carried out for several hours to nearly a day, after which the irradiated ice was warmed to room temperature. The vacuum ultraviolet photo-absorption spectrum recorded at room temperature showed an aromatic residue to be leftover on the LiF window. While imaging the leftover residue using an electron microscope, crystals of various sizes and shapes, cubes, spheres, and triangular prisms were observed. The results suggest such geometrically shaped aromatic interstellar dust particles may be present.

[1] Callahan M. P. et al. (2019) *Icarus, 226,* 1201-1209. [2] Strazzulla G. and Baratta G. A. (1991) *A&A, 241(1),* 310-316. [3] James R. L. et al. (2019) *RSC Adv, 9,* 5453–5459. [4] Brunetto R. et al. (2006) *ApJ, 644*, 646.