Nitrogen inclusion in organic dust in novae revealed by laboratory synthesis of Quenched Nitrogen-included Carbonaceous Composite (QNCC)

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The unidentified infrared (UIR) bands have been widely observed in various astrophysical environments. They consist of a series of emission features arising from aromatic and/or aliphatic C-C and C-H bonds in the near- to mid-infrared wavelength range[1] and therefore, their carriers are thought to be related to organics. Although the carriers must be a major constituent of the Galaxy, our knowledge of their properties is still limited. Dusty classical novae are valuable to investigate the formation process of dust because of their high occurrence. Past studies have shown that the UIR bands in novae are characterized by the presence of a broad 8μm feature [2,3].

We have succeeded to synthesize Quenched Nitrogen-included Carbonaceous Composite, laboratory organics whose infrared properties cane reproduce the UIR bands in novae. QNCC is synthesized by quenching plasma produced from nitrogen gas and hydrocarbon solids. This synthesis method qualitatively mimic a possible formation process of organics in the circumstellar environment of novae, where nitrogen-rich novae wind react with pre-existing carbonaceous dust. Based on the infrared and X-ray analyses of QNCC, we found that QNCC show the presence of amine structure, which can contribute to the broad 8μm feature characterizing the UIR bands in novae. QNCC is at present the best laboratory analog of organic dust formed in circumstellar environments of dusty classical novae[4].

References

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