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Origin of milky optical features in type IaB diamonds: Dislocations, nano-inclusions, and polycrystalline diamond

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ABSTRACT

The milky appearance shown by certain type IaB diamonds has been subjected to several recent studies, but the origin of this feature is not fully understood. Here several type IaB diamonds with a milky appearance have been studied by cathodoluminescence (CL), electron backscatter diffraction (EBSD), and transmission electron microscopy (TEM). CL of several hazy type IaB diamonds shows scattered or orientated micro-sized spots or short linear luminescence features. TEM observation revealed that those spots and linear features are caused by dislocation loops that are likely responsible for the hazy appearance of the host diamonds. It is also shown that type IaB diamonds with a cloudy appearance contain nano-sized inclusions with negative crystals of octahedral shape. Some of these negative crystals contain a precipitate that can be explained by a compressed disordered cubic δ-N_2 phase observed by high-resolution TEM. In one of the milky IaB diamonds with platelet defects, polycrystalline areas composed of columnar diamond crystals elongated radially in [110], similar to ballas diamond, were revealed by EBSD. Taking into account these observations, it is suggested that the dislocation loops, nano-sized inclusions (negative crystals) and/or characteristic grain boundaries of the radiating fibrous crystals would be the origins for the milky appearance of the type IaB diamonds studied here. Those results add a complementary explanation that accounts for the milkiness of type IaB diamonds studied before.

Keywords: Type IaB diamonds, milky, dislocations, voidites, polycrystalline diamond; Nanominerals and Mineral Nanoparticles