European Mineralogical Conference
Vol. 1, EMC2012-325, 2012
European Mineralogical Conference 2012

Growth and post-growth defects in a natural diamond from Finsch mine (South Africa)

G. Agrosì (1), G. Tempesta (1), E. Scandale (1), and J. W. Harris (2)

(1) Dipartimento di Scienze della Terra e Geoambientali, Università degli studi Aldo Moro Bari, Italy (giovanna.agrosi@uniba.it), (2) Department of Geographical and Earth Sciences, University of Glasgow, Glasgow G12 8QQ, UK

In recent years several studies were focused on the calculation of residual pressure around mineral inclusions in diamond in order to provide useful information on the depth of diamond origin. In these studies, the calculations were carried out using mainly vibrational spectroscopy data and were based on different assumptions including also the following important postulations: the diamond deforms elastically, no plastic or brittle deformation taking place during transportation to the surface, and the remnant pressure of the inclusion is the only cause of strain in the diamond that results in anomalous birefringence. [1]

An helpful tool to verify the existence conditions of the aforementioned assumptions can be obtained by the analyses of structural defects using X-Ray Diffraction Topography (XRDT), a non-destructive imaging technique, sensitive to the strain associated with extended defects. This technique is particularly suitable for providing information about crystal growth and genetic environment of minerals by recording the spatial distribution of lattice defects and by the discrimination between growth and post-growth defects [2, 3, 4].

In this study a natural diamond from Finsch mine (South Africa) was investigated by XRDT in transmission geometry, using MoKα1 radiation with conventional source. The sample (F118) was a polished plate, about 1mm thick and cut perpendicular to [111]. The plate showed anomalous birefringence and a typical triangular shape with a rounded side in which re-entrant corners could be seen. X-ray topographs show that the sample is actually a mosaic crystal that developed through aggregation of individuals during growth: some slightly rotated relative to one another and others twinned. The twin law is by reticular merohedry and consists of the well-known 2-fold rotation around [111]. The larger inclusions are garnet crystals absorbed in the inner part of an individual showing triangular shape. No dislocations are nucleated from them. A number of inclusions were adsorbed at the interfaces between the twinned individuals and at the grain boundaries. Bundles of dislocations run from the smaller inclusions adsorbed in the outer region of the triangular individual. In the whole sample and chiefly in the regions showing a lower density of inclusions, packed lamination lines parallel to an octahedral face can be observed. These laminations represent a polysynthetic twinning commonly observed in diamonds when a plastic deformation occurs and thus can be considered post-growth defects. Finally, this study results useful to determine the strains associated to the inclusions and the presence of plastic deformation related to post-growth defects and thus can contribute to select the diamond samples and the inclusions suitable to provide information on the depth of diamond origin.

REFERENCES

[1] D. Howell, I. G. Wood, D. P. Dobson, A. P. Jones, L. Nasdala, J. W. Harris: Contrib Mineral Petrol (2010) 160 705–717
[2] G. Agrosì, G. Tempesta, G.C. Capitani, E. Scandale, D. Siche: Journal of Crystal Growth (2009) 311 4784–4790
[3] G. Agrosì, F. Bosi, S. Lucchesi, G. Melchiorre, E. Scandale: American Mineralogist, (2006) 91 944.952
[4] E. Fritsch, M. Moore, B. Rondeau, R. G. Waggettb: Journal of Crystal Growth (2005) 280 279–285