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CONTENTS

Raman Investigations of Bio-SiC Ceramics

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Abstract: Structural properties of biomorphic SiC ceramics are investigated by Raman spectroscopy. Compressive stress in residual silicon inclusions inside pores is detected. Presence of graphite clusters is revealed with help of surface enhanced Raman spectroscopy. Keywords: bio-SiC, Raman spectroscopy, SERS

In recent years new materials for bioimplants and lightweight structural components fabrication is getting a great interest. One of the aforementioned materials is biomorphic SiC (bio-SiC). It is produced from natural wood precursors by pyrolysis in argon or N_2 and subsequent forced infiltration of obtained biocarbon template with liquid silicon at high temperatures. Resulting bio-SiC material preserves structural hierarchy and open porosity of initial wood, but acquires high durability and rather good mechanical properties with respect to compression and flexure. Moreover, details of complicated form can be easily shaped from wood before the pyrolysis process. The component composition of the SiC/Si/C composite samples obtained depends on γ = Si/C mass ratio during fabrication in crucible and other technological conditions.

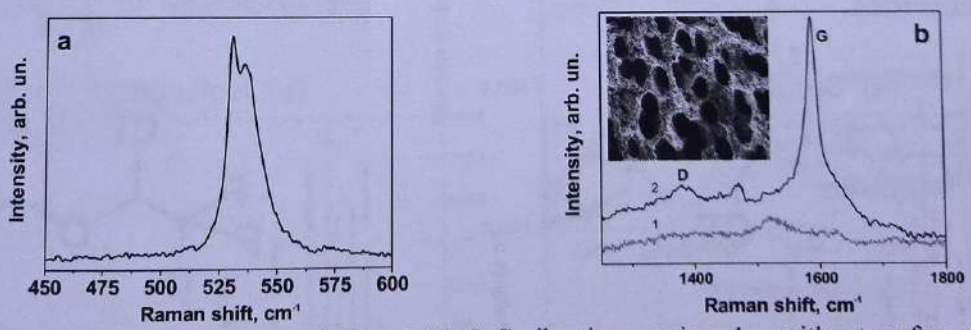

Figure 1. Raman spectra of bio-SiC in (a) Si-Si and (b) C-C vibrations region: 1 – without surface enhancement; 2 – with surface enhancement. Inset shows SEM-image of investigated structure.

Bio-SiC structure investigations by means of Raman spectroscopy have allowed to establish that synthesis temperature ~1550°C results in 3C-SiC polytype formation. Increase of synthesis temperature leads to 3C as well as 6H SiC formation. Further temperature increase up to 2100°C results in increase of 6H polytype fraction. For composites with the mass ratio γ >2.33 the bands are observed around 520-540 cm^{-1} which evidence the presence of residual silicon, which is under great compressive stress, inside the SiC pores (Fig. 1 a). Using of surface enhancement effect by silver nanocrystal film deposited on bio-SiC has allowed us to register D (1355 cm^{-1}) and G (1607 cm^{-1}) lines in C-C vibrations range, which correspond to disordered carbon phase and graphite phase, respectively (Fig. 1 b).