Influence of the additives of multi-walled carbon nanotubes to the porosity of hydroxyapatite composite

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Results

Hydroxyapatite (HA) powder was synthesized by the reaction between calcium carbonate and orthophosphoric acid. Composite ceramics based on hydroxyapatite (HA) with additives of multi-walled carbon nanotubes (MWCNTs) have been sintered in the Ar atmosphere. The concentration of nanotubes was varied in the range 0 - 0.5 wt%. HA is a bioactive matrix, while MWCNTs additives can improve the mechanical properties of ceramics. In particular, the additives of MWCNTs lead to the unique electrical, thermal, and mechanical properties of composite materials.

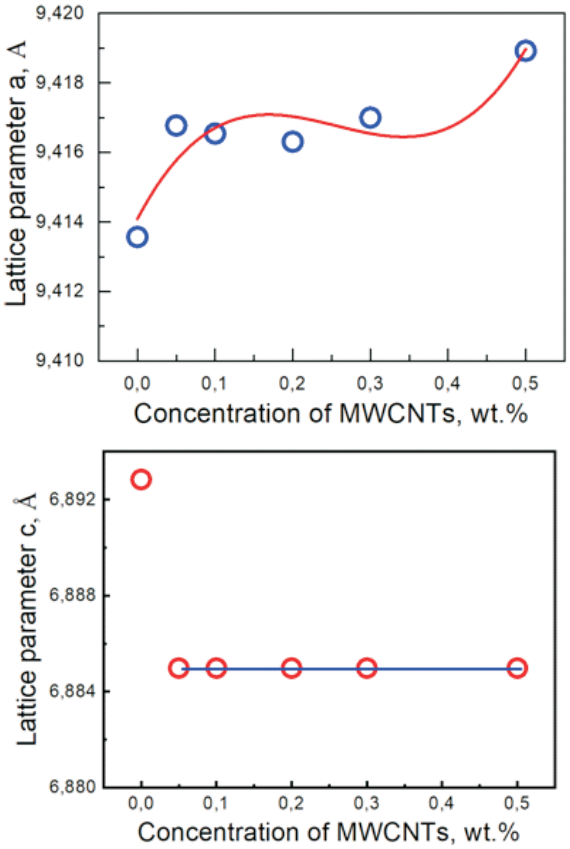

Fig. 1. Lattice parameters (a = b, and c) for the hexagonal structure of the HA composite ceramic vs. MWCNTs amount.

X-ray, IR, and TEM have been studied. In addition, the increase of the density and decrease of the porosity have been observed. The obtained results are discussed. It was found that HA ceramics has higher macrostresses than in the case of HA ceramics with the additives of MWCNTs. HA ceramics have low thermal diffusivity and the temperature gradients occur during heterogeneous heating/cooling of different parts of ceramics at sintering. The additives of MWCNTs allow to increase the thermal diffusivity and reduce internal residual macrostresses in the HA-MWCNTs ceramics.

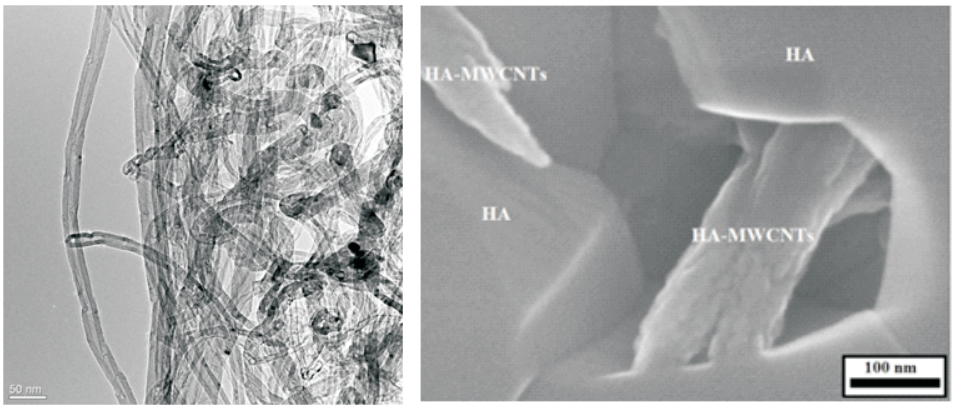

Fig. 2. TEM image of MWCNTs and SEM image of the hydroxyapatite ceramic with the MWCNTs, sintered in Ar atmosphere at 1100 C.

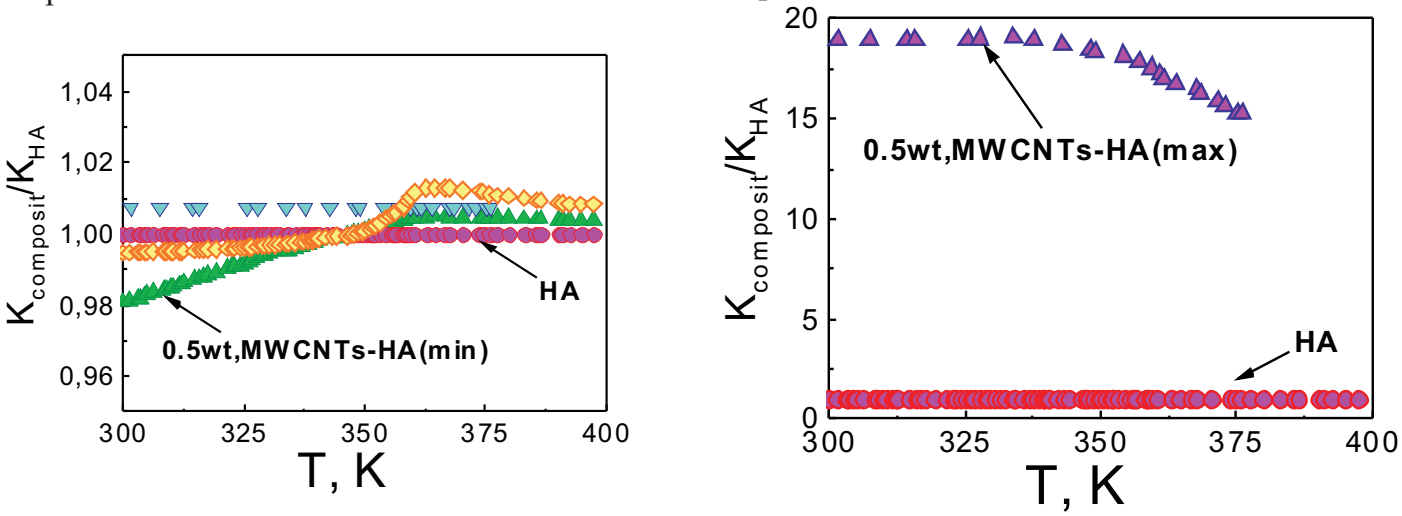

Fig. 3. The calculated normalized thermal conductivity of HA-0.5 wt.% MWCNT composite to the HA matrix.

Conclusions

It was found that MWNTs can contribute to increasing of the coefficient of thermal conductivity and thermal diffusivity of the HA ceramics, due to their unique structure and high anisotropy of the MWCNTs.