Si_3N_4 / graphene based composites: structure and properties

Csaba Balazsi[1], Orsolya Tapaszto[2], Zsolt Fogarassy[2], Jan Dusza[3], Andreas Kailer[4], Katalin Balazsi[2]

[1] Bay Zoltán Nonprofit Ltd. for Applied Research, Fehérvári str. 130, 1116 Budapest, Hungary
[2] Thin Film Physics Department, Institute for Technical Physics and Materials Science, Centre for Energy Research, Konkoly-Thege M. str. 29-33, 1121 Budapest, Hungary
[3] Institute of Materials Research, Slovak Academy of Sciences, Watsonova 47, 040 01 Kosice, Slovakia
4 Fraunhofer-Gesellschaft – Institute for Mechanics of Materials IWM, Wöhlerstraße 11, Freiburg, Germany

*balazsi.katalin@energia.mta.hu, + 36 1 392 2249

Silicon nitride is a promising structural ceramic material that was developed in a search for high strength and high toughness ceramics that could replace metals in advanced turbine and reciprocating engines to give higher operating temperatures and efficiencies. During the last few years new cost effective, high quality carbon based filamentous was developed in the form of graphene platelets (GPLs), also called graphene nanoplatelets (GNP), multilayer graphene nanosheets (MGN) or graphene nanosheets (GNS). These platelets demonstrate exceptional high thermal and electrical conductivity and an exceptional combination of mechanical properties.
Recent basic research on the development of graphene containing ceramic composites has shown that it is possible to realize nanocomposites with remarkably increased wear resistance and fracture toughness. In addition, electrical conductivity values can be reached that will be useful to gain further functionalities. It is expected that further improvements will be realised, if it is possible to synthesise functionalised graphenes that are homogenously dispersed in and strongly bond to a pore-free ceramic matrix, which is necessary to further enhance the fracture toughness and strength. Tribological tests of graphene dispersed in water showed that even under severe conditions (boundary lubrication) friction and wear of ceramic matrices can be maintained on a very low level.

The aim of the present work is to investigate the influence of the addition of various kinds of graphene nanoplatelets on the structure and other properties of Si_3N_4 based composites prepared by high efficient attritor milling and sintered by spark plasma sintering.

Acknowledgement
Authors thanks to M-ERANET „Grace” Graphene-ceramics composits for tribological application in aqueous environments.