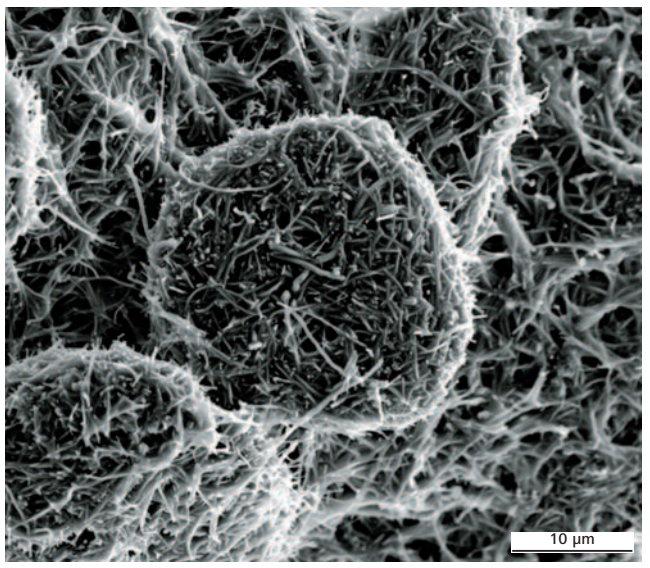
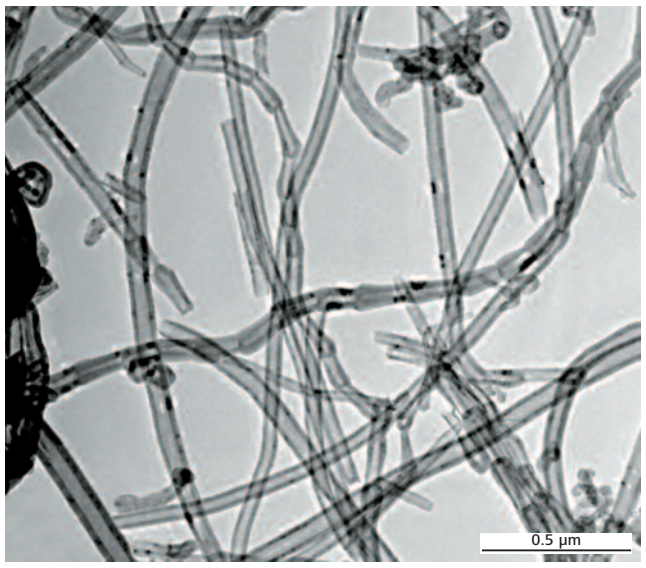
Processsing and Properties of Alumina/ Carbon Nanofiber Ceramic Composites

EMPA
Materials Science & Technology

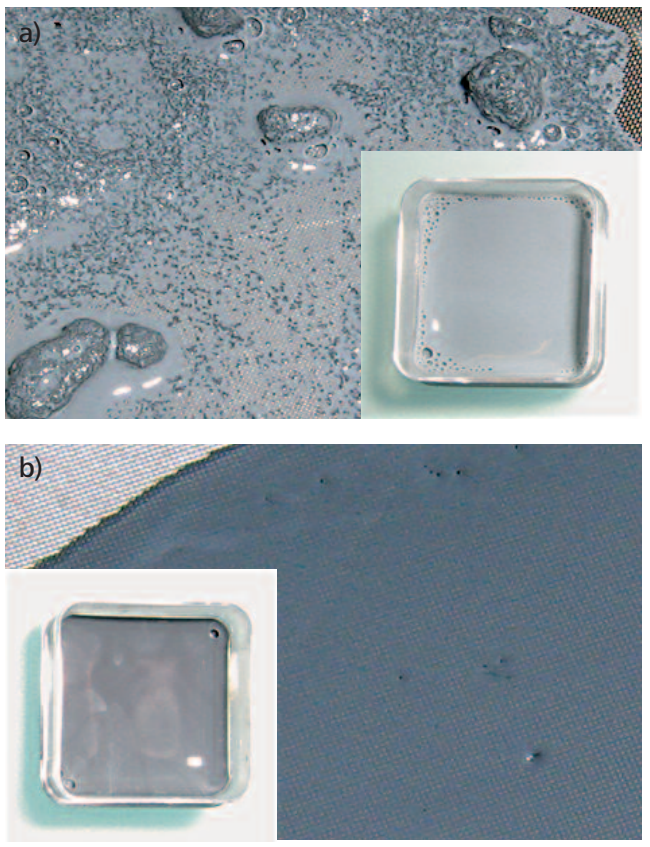
Gurdial Blugan[1], Jakob Kübler[1*], Monkia Michalkova[2], Pavol Šajgalík[2] , T. Minghetti[3], C. Schelle[3]

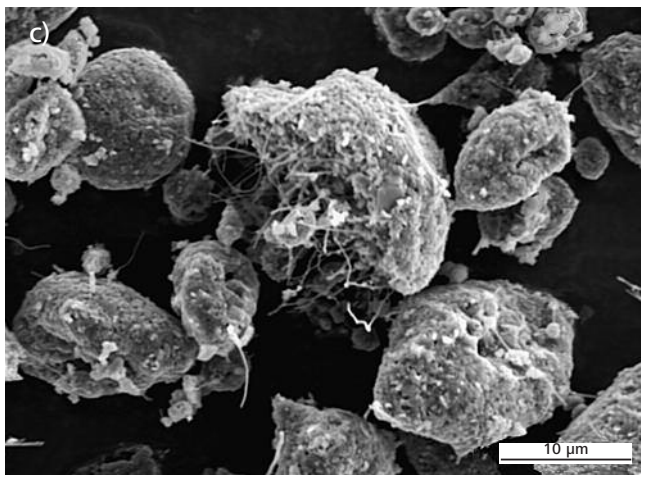
Carbon nanofibres (CNFs) of 50-600 nm diameter and several microns long were homogenously introduced into a sub-micron alumina (Al_2O_3) ceramic matrix to produce electrically conductive ceramic matrix composites. The CNFs agglomerate into large bundles and have to be separated (see TEM image).



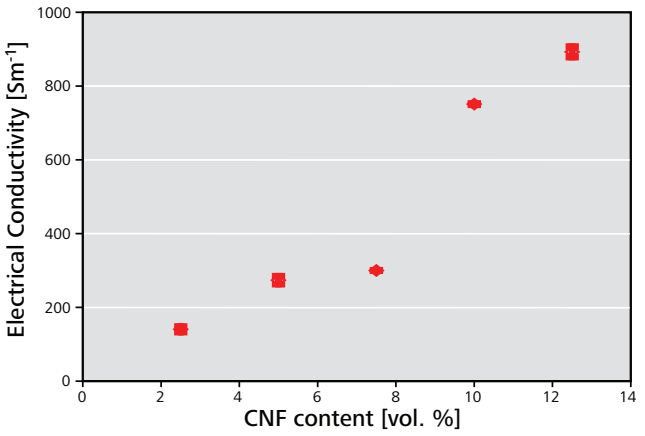


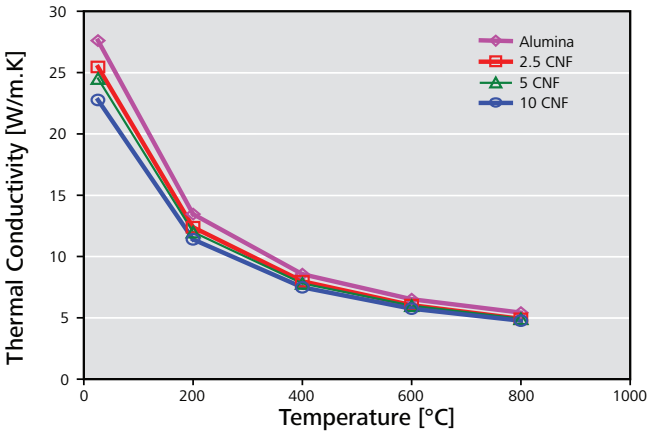
The effect of milling the Al_2O_3 and CNFs slurry without and with Darvan C-N is shown (for a slurry with 7.5 vol.% CNF) in (a) and (b) respectively. Large bundles and small agglomerates of CNFs still exist when no Darvan C-N is used. The slurry was then spray dried before die pressing and sintering by hot pressing (c).



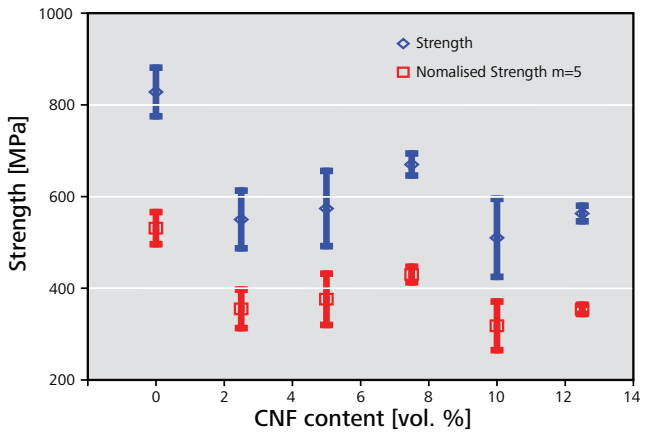


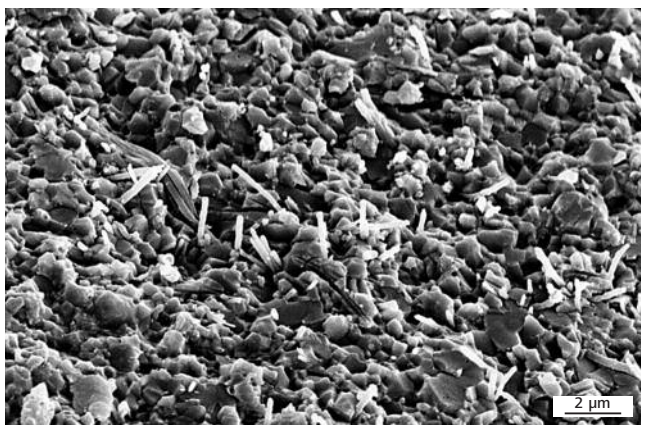
The electrical conductivity shows an almost linear increase with increasing CNF content. The slight deviation shown at 7.5 vol.% CNF content is due to a different milling procedure which reduced the effective dispersion. The increasing CNF content gives a small decrease in the thermal conductivity due to the introduction of microscopic defects.





Three point bending strength tests were performed on bars of 1.7 x 2 x 20 mm dimension. The results were adjusted with a Weibull correction taking into account the small specimen size are also shown (20 x 3 x 2 mm). A 40 % decrease in strength is observed by the introduction of CNFs, this decrease in strength is stable up to 12.5 vol.% CNF content. Failure is due to a combination of CNFs and ceramic defects.





* jakob.kuebler@empa.ch
1 Empa Swiss Federal Laboratories for Materials Science and Technology, Laboratory for High Performance Ceramics, Ueberlandstrasse 129, 8600 Duebendorf, Switzerland.
2 Institute of Inorganic Chemistry, Slovak Academy of Sciences,Bratislava, Slovakia.
3 Ruag Technology , Industriezone, Schachenwald, 6460 Altdorf, Switzerland.