NASTRAC Project – 24 Month Progress Report – November 2010

During the past 12 months, important progress towards target factory / in-service trialling in quarters 10,11 and 12 has been made as follows:

Nano-Barium Titanate systems for Multi-Layer Ceramic Capacitors (MLCC)

Working with a US dopant supplier, an optimised wt% loading has been identified. In addition a range of glass frits has been evaluated and a preferred composition and wt% loading found.

A final barrier to overcome is ink rheology. Using bead milling, it is hoped that issues concerning powder agglomeration and deposited layer unevenness can be overcome.

As far as electrical properties are concerned, micro-wave assisted firing has assisted in the generation of XR7 and XR8 properties at a much lower sintering temperature. This brings potential benefits in terms of reduced costs for electrode materials.

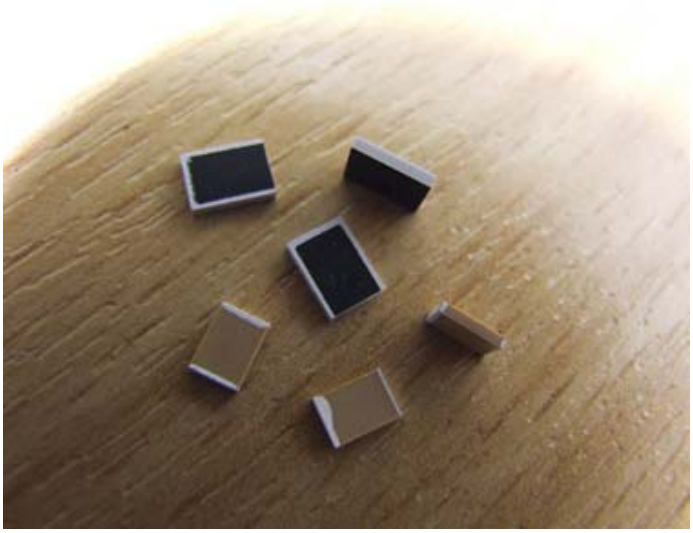
Nano-zirconia Systems for highly abrasive aqueous environments where metal alloys fail

The excellent hydrothermal ageing properties highlighted below have stimulated Valve Solutions to secure interest amongst 3-4 of their clients for field trials featuring nano-zirconia valve inserts. At the start of the supply chain, project partner MEL have progressed scale-up of the concentrated nano-zirconia slurries used for granulation.
In terms of shaped component consolidation, it has been seen that Micro-Wave Assisted firing has little benefit in terms of delivering a final nano-structure in zirconia systems. Instead, novel temperature versus time sintering profiles are to be employed.

Spin-off opportunities

At the quarter 8 status meeting held at Syfer Technology Ltd, Norwich, a number of foreground Intellectual Property opportunities were cited. These concern scaled-up production of concentrated nano-slurries, novel nano-zirconias with improved abrasion and hydrothermal ageing resistance properties and novel nano-BT capacitors. Options for patent protection are being explored.

Perhaps the most exciting discovery is the observation that nano-zirconia components containing (a) an optimised level of yttria and (b) grain sizes of <180nm in the final sintered structures have phenomenal resistance to hydrothermal ageing even with 5-10% porosity present. This finding has stimulated a new project submission to the Technology Strategy Board (TSB) under the autumn 2010 “Technology Inspired Collaborative R&D” call. Working with a major advanced ceramics producer, the proposal aims to investigate nano-zirconia in mono- and composite bone replacement systems. An ultimate goal is to employ impregnation of any residual porosity to encourage bonding of load-bearing zirconia components to bone. The afore-mentioned proposal has now (January 2011) been short-listed for a stage 2 evaluation. If successful, work could commence in Qtr 2/3 this year.



Prototype MLCCs featuring nano barium titanate. Picture shows both pre-sintered components (black) and post-sintered (gold) components that have been end-terminated with electrode