Robert C Pullar, Materials Science and Nanotechnology

# Hexagonal ferrite Ecoceramics: Magnetic biomorphic / biomimetic 3DOM foams produced using cork as a natural sustainable template

**Robert C Pullar**
University of Aveiro, Portugal

Ecoceramics (environmentally conscious ceramics) are a new class of biomimetic / biomorphic material that can be manufactured from renewable resources, such as wood from sustainable sources or wood wastes. The idea is to manufacture ceramics with the microstructure of wood. To this end, the wood is pyrolysed to convert it into carbon, which is very porous but maintains the microstructure / morphology. It is possible to infiltrate this carbon matrix with a ceramic precursor, and then heat it to around 1000 °C in air to burn out the carbon and form the ceramic. The end ceramic product also has the microstructure of the wood template. We have done this for the first time using cork, which is an extremely lightweight material. It is a fully sustainable / renewable resource, as the bark is harvested every 8-13 years, without harming the tree, which continues to live on as a carbon sink for a productive lifetime of at least 200 years. Portugal is the world's largest cork producer, accounting for about 40% of annual global cork production. Cork has a 3DOM microstructure of 20 m diameter hexagonal cells. Hexagonal ferrites are hugely important magnetic ceramics, with a multitude of applications beyond their standard magnetic properties, in electronics, electric motors, microwave (GHz) devices, stealth and RAM (radar absorbing materials). The pyrolysed cork was mixed with precursor solutions and heated to 1000-1200 °C to make magnetic hexaferrite ecoceramics, which maintained the cellular and highly porous microstructure of cork. Examples include $Sr_3Co_2Fe_{24}O_{41}$ (SrZ), $BaFe_{12}O_{19}$ and (BaM) and $SrFe_{12}O_{19}$ (SrM). The resulting materials are entirely ceramic, but with the very light and porous structure of Cork - a "magnetic ceramic foam" - and excellent magnetic properties. Our SrZ hexaferrite ecoceramics were recently selected as the cover image for the January 2017 issue of *Materials Today*.

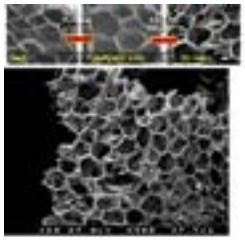

**Figure 1:** Synthesis process for cork-derived hexaferrite ecoceramics. Corkwood (left) is pyrolysed under $N_2$ at 900°C, and converted to a carbon template (centre). This is then infiltrated with a precursor solution, and when heated in air this converts to a pure ceramic (hexaferrite in this case) with the porous, lightweight cellular microstructure of cork (right).

**Figure 2:** SEM image of SrZ ecoceramics, selected for cover image of [3].

## Biography

Robert C Pullar completed his PhD at the University of Warwick (he was the first person to ever produce hexaferrite ceramic fibers), and after working as a post-doc in London at South Bank University and Imperial College, is now a Principal Investigator in the University of Aveiro, Portugal. He has published >115 papers (h-index =26), with 25 and 2 book chapters on ferrites, including a major review [1] which is now the most cited hexaferrites paper of the last 50 years (>450 citations). He is an Associate Editor of RSC *Advances*, and is a Fellow of the Royal Society of Chemistry (FRSC).

rpullar@ua.pt

Notes: