GlaCERCo: Glass and Ceramic Composites for High Technology Applications – Marie Curie Initial Training Network

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Guest editorial

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New high-tech glass-based materials (glasses, glass-ceramics, glass- and glass-ceramic composites and fibres) are themselves an emerging supra-disciplinary field: expertise on these new materials brings competitiveness in strategic fields, such as medicine (bioactive glasses as bone replacement and drug delivery systems), telecommunications (glass devices for broad-band applications), photonics (glass based photonic sensors), clean energy (Solid Oxide Fuel Cells glass sealants, thermoelectric materials), waste management (vitrification and re-use of wastes), oil and gas exploration and carbon capture (glass reinforced plastic pipes).

The GlaCERCo project, an ITN Marie Curie training network funded by the EC from 2011 to 2015, developed advanced knowledge in glasses, ceramics and composites. This included innovative, cost-competitive and environmentally acceptable materials and processing technologies. Seventeen early stage researchers and six experienced researchers were trained within this innovative training programme (www.glacerco.eu).

GlaCERCo was an inter/multi-disciplinary and inter-sectorial programme as it included five academic partners and five companies, from six countries: Politecnico di Torino - project coordinator - (I), University of Erlangen-Nuremberg (D), Centre National De La Recherche Scientifique (F), Universita degli Studi di Padova (I), Institute of Physics of Materials (CZ), Element Materials Technology Hitchin Ltd (UK), Colorobbia Italia SpA (I), Nanoforce Technology Limited (UK), nLIGHT Corporation (FIN), and Nuova Ompi s.r.l. (I).

This special issue of Advances in Applied Ceramics includes eleven invited papers, which reflect the broad range of research activities conducted within the framework of GlaCERCo, such as:

(i) Vitrification and reuse of industrial waste (e.g. biomass ash, iron rich slags, air pollution control residues, etc.) and investigation of the reuse of the so obtained glasses and glass-ceramics as raw materials for the manufacture of building materials with improved properties, or as new sustainable building materials and special cement production.

(ii) Development and characterisation of advanced composites with improved mechanical properties. The reinforcements studied included boron nitride nanosheets and graphene nanoplatelets. The new composites, developed within GlaCERCo, show higher fracture toughness, flexural strength and scratch resistance compared with the matrix materials.

(iii) Design, synthesis and characterisation of special glasses for thermoelectric (TE) applications. New stable tellurite glasses and glass-ceramics for thermoelectric applications exhibiting low electrical resistivity and high stability were obtained. The glass-ceramics explored in this work exhibited good TE performance and at the same time maintained the advantages of glass (including low thermal conductivity, low sintering temperature and high formability).

(iv) Design, preparation and characterisation of new glasses suitable for bone substitution (i.e. glass and glass-ceramic macroporous scaffolds) and arthroprosthesis (i.e. bioactive glasses). The innovative glass, glass-ceramic and composite coatings and scaffolds developed by the GlaCERCo consortium showed improved mechanical properties and bioactivity with interesting potential for their further exploitation (for example in bone healing clinical devices).

(v) Joining and coating. A new self-healing glass-ceramic sealant for the integration of ceramic components in solid oxide fuel cells (SOFC) stacks has been designed, produced and validated. The comparison of two different test methods are discussed with the aim of measuring the pure shear strength of glass ceramic joined samples. Besides, it was also demonstrated that embedded glass fibre based evanescent sensors were able to detect the early stage of moisture diffusion in glass reinforced polymer (GRP) composites under hostile environments. The extremely low cost, associated with the production of these sensors, will allow them to be applied to the development of smart coatings for GRP.

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Guest editors

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