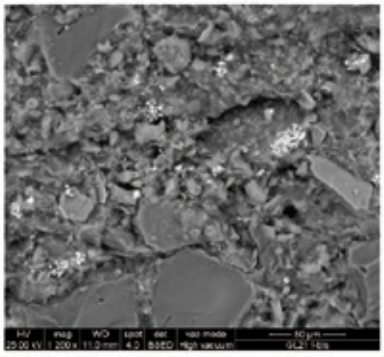
Dielectric composites with tailored magnetic nanoparticles

A series of new inorganic magnetic composites (IMCs) has been prepared to obtain magnetic materials with tunable thermal and mechanical resistance properties. Indeed, in the field of power inductive components, inductive heating and cooking, they may transfer energy with high robustness and excellent performance. Moreover, these materials may mitigate electromagnetic interference (EMI) at frequencies in the LF and MF band.

The composites (Figure 1) have been synthesized by using alkaline or acidic activation processes, carried out in the presence of commercial nanoparticles (isotropic and anisotropic Sr-ferrite). Three different inorganic matrices have been prepared by varying the type of activator, slag addition, water content, and aggregates.

The matrices prepared in alkaline conditions and the one in acidic ones will allow the investigation of the electrical properties, which are known to depend strongly on the activation conditions due to the different ionic content.

Figure 1: Sample of magnetic composite.

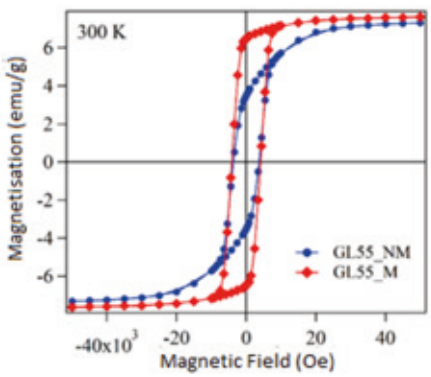


The SEM images (Figure 2) show that there is a noticeable tendency for magnetic particles to aggregate in the matrix. Isolated single magnetic particles are rare.

Figure 2: The particles of magnetic powder in the back-scattered electron SEM images of a sample obtained in basic conditions appear lighter than the matrix.

The hysteresis cycle (Figure 3) of the samples obtained under a magnetic field (M) is more square than that of the corresponding samples produced without the effect of the field (NM). This influences the value of the residual magnetization and therefore of the dispersed field generated by the sample.

Figure 3. The effect of the magnetization process during the solidification of the samples. Comparison of the magnetization cycles on M (field on) and NM (field off) samples with a nominal concentration of particles ~ 10%.



Research topic:
Materials

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Main research topics:

- Magnetic nanoparticles;
- Inorganic polymers;
- Composite materials