Spiral magnets: Magnetoelectric building blocks

Magnetoelectric multiferroics are an emerging class of materials that combine coupled electric and magnetic dipole order. In these materials, ferroelectric and magnetic (ferromagnetic or antiferromagnetic) states can coexist or compete with each other. The interaction leads to the so-called magnetoelectric (ME) effect, which is the induction of magnetization by an electric field or electric polarization by a magnetic field, offering the possibility of a new generation of ultra-low power devices. The magnetically induced ferroelectrics often show giant ME effects, remarkable changes in electric polarization (P) in response to a magnetic field, because the origin of their ferroelectricity is driven by magnetism that sensitively responds to an applied magnetic field.

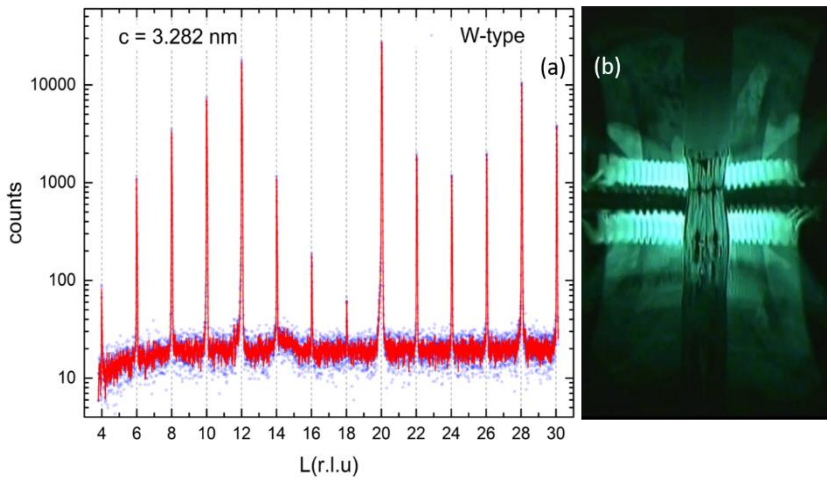

Figure 1:(a) XRD of the W-type hexaferrite grown by the zone float technique (b).

Among the ME multiferroics reported, hexaferrites show potential for device applications as they exhibit a low field ME effect. We have recently grown both M-type and W-type Co doped hexaferrite single crystals using the zone float technique (EP/P020534/1), see Fig.1, that have non-collinear magnetic order, a key indicator of a possible ME response.

This PhD project will focus on resonant soft X-ray diffraction, RSXD, in order to study magnetic order as a function of Co doping in the parent compound.

Using a combination of techniques (RSXD with polarization analysis, magnetometry and magnetoelectric response) you will (a) elucidate the B-T dependent conical phases of the material, (b) correlate the physical and magnetic structures with the M-H and P-E measurements and (c) understand how sensitive these properties are to the proportion of Co doping in the unit cell.

The PhD studentship is fully funded (fees and stipend) for 3.5 years.

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