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Microstructural and electrical characterization of superconducting MgB2 thick films produced by aerosol deposition technology

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The project consists of producing superconducting magnesium diboride (MgB2) thick films deposited by special film formation process called aerosol deposition method. They will be used in power generators of wind turbines. Within the project, MgB2 layers are formed on various substrates like metal or glass. The focus is on two problems about MgB2 production using aerosol deposition method. First challenge is the high affinity of magnesium to oxygen. The second is low connectivity and porosity. The former makes it hard to manufacture MgB2 without MgO formation even if high purity boron, magnesium and protective atmosphere are used. The latter leads to poor superconducting current density (Jc) and risks the reproducibility, as varied Tc and Jc are obtained even under the same conditions.

For high quality film formation, powder treatment is one success factor. As-received powder is milled under different parameters, x-rayed and scanned under SEM to get the required analytics. The prepared powder are dispersed in dry gases and accelerated into vacuum to form a layer on the substrates, where a dense nanograined film is deposited. Several analysis techniques like SEM, FIB-SEM and EDX are used for the analytics of the microstructure of deposited films. Electrical measurements including conductivity, critical current density and critical temperature are done to determine the electrical and superconducting properties. Methods to combine microstructural and electrical properties of approximately 5µm thick superconducting layers are researched.

For future work, after deposition under different parameters, the grain connectivity inside the structure will be investigated with the aim of looking on improvement of it by porosity and crack reduction in the structure as well as MgO content reduction and distribution. Delta resistivity measurements under cryogenic temperatures will also be used to investigate the grain connectivity.

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