Progresses in $Mg^{11}B_2$ Superconductor Initiatives in India

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Subrata Pradhan

Institute for Plasma Research, Bhat, Gandhinagar 428 328, Gujarat, Inida

Background

Future Fusion Relevant Magnets are expected to operate in neutron irradiated environments. ^{11}B isotope (in MgB_2 intermediate superconductor) is known to have significantly reduced neutron capture cross section and has less cool down time compared to conventional Niobium (Nb) based low Temperature superconductors. Additionally, MgB_2 superconductors can be operated at 20 K eliminating the costly usage of liquid helium. Scientific Research Council of Department of Atomic Energy (DAE-SRC), Govt of India recognizes $Mg^{11}B_2$ as an appropriate superconductor in fusion relevant magnets & have launched a program on it since 2016.

Objectives

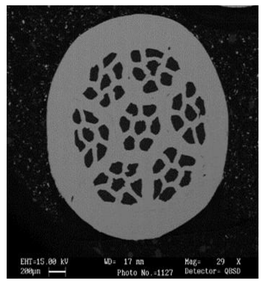
- Development of $Mg^{11}B_2$ strands and cables in long lengths including joints between the strands and cable.
- Validation of a $Mg^{11}B_2$ based prototype magnet in self field.

Conclusion

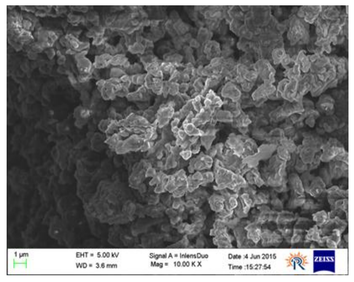
- Synthesis of amorphous (11)B have been successful in association with Pavezyum (Turkey)
- Basic kinetics studies, intrinsic and extrinsic property optimizations on $Mg^{11}B_2$ samples have been going on successfully.
- Monofilamentary and Multifilamentary strands of MgB_2 strands in long lengths have been successfully fabricated. Trials are ongoing to realize long lengths of $Mg^{11}B_2$ strands.
- A cable-in-conduit-conductor design is going on involving $Mg^{11}B_2$ strands .
- Superconducting joints have been successfully made using MgB_2 monofilament strands. These considerations will be shortly extended to multifilament $Mg^{11}B_2$ strands.
- $Mg^{11}B_2$ strands in long length are expected in 2018, $Mg^{11}B_2$ cables in long lengths are expected in 2019 and a $Mg^{11}B_2$ based prototype magnet is expected in 2021 as per DAE-SRC project deliverables.

Strands

A forty nine filament strand

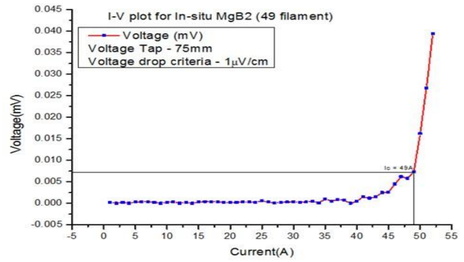


SEM picture

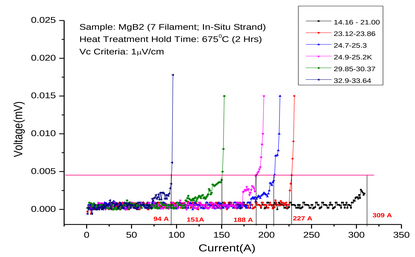


Cryo cooler based characterization facility

A typical Characterization result



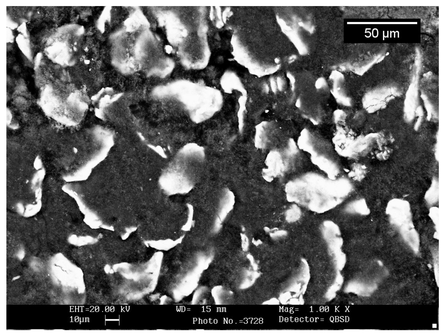
A 7-filament Characterization result



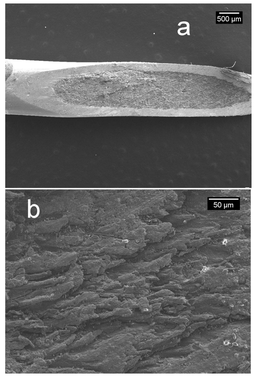
Joints

Superconducting Joints

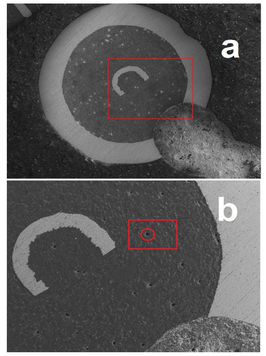
SEM Image of as mixed Mg and B powder



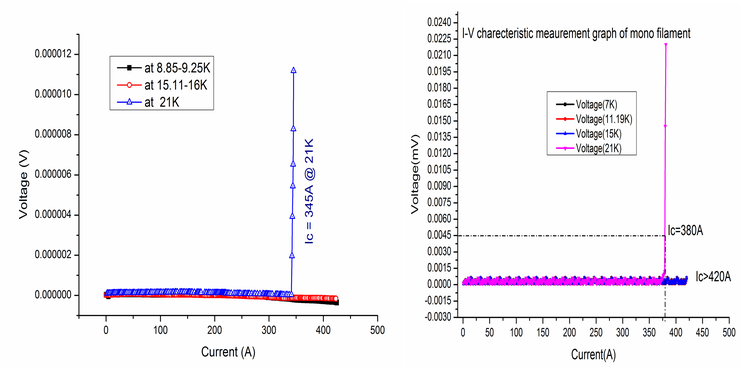
SEM image of sheath removed portion of joint



Cross section view of Joint portion



I-V measurements of joints samples



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