

Extra-lightweight MgB_2 composites aimed for future aircrafts and spacecrafts

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Abstract

Functional superconductors are usually composite wires consisting of superconducting filaments inside a several metallic sheaths playing the role of inter-diffusion protection (diffusion barrier) and also the role of electrical and mechanical stabilization. Up to now, MgB_2 phase is the lightest existing superconducting compound with specific mass of only 2.5 g cm^{-3} . The combination of MgB_2 filaments with Ti-barriers and Al-stabilization outer sheath would provide a composite wire with the minimal mass. But, pure Al is too soft to be used for the outer sheath of composite wires subjected to apparent cold deformation by drawing or rolling. Therefore, micro-structure and properties Al+ Al_2O_3 material produced by powder metallurgy was carefully tested and then successfully utilized for composite $MgB_2/Ti/Al+Al_2O_3$ wire. Mechanical and electrical properties of such wire were examined at low temperatures and used also for the superconducting coil made by wind and react process with utilization of self-insulated $15 \mu\text{m}$ Al_2O_3 layer created on the wire surface by the anodic oxidation. Very thin and high temperature resistant Al_2O_3 layer offers high space factor which maximize the current density and winding efficiency. High electrical performance and also tolerance to axial stress have been obtained for $MgB_2/Ti/Al+Al_2O_3$ wires at low temperatures. Such lightweight MgB_2 composite conductors can be especially interesting for future high power density aircraft engines and also for some of space applications (e.g. active magnetic shielding), where the total mass of system is important issue.



Biography:

Pavol Kováč has completed his PhD in 1988 at Faculty of Electrical Engineering of the Slovak Technical University in Bratislava. He is the head of the Department of Superconductors in the Institute of Electrical Engineering of Slovak Academy of Sciences and the number of editorial board

of. He has published more than 300 papers in reputed journals and has been serving as an editorial board member of the Journal of Superconductor Science and Technology.



Speaker Publications:

1. P Kováč, L Kopera, M Hain, E Martínez, J Kováč, T Melišek, D Berek and I Hušek, MgB_2 cables made of thin wires manufactured by IMD process, Superconductor Science and Technology, Vol.32, No.8, pp. 085004.
2. P Kováč, M Bonura, S Santra, L Kopera, A Rosová, C Senatore and I Hušek (2019), Thermal conductivities and thermal runaways of superconducting MgB_2 wires stabilized by an Al + Al_2O_3 sheath, Superconductor Science and Technology, Vol.32, No.11, pp. 115007.
3. S. Santra, C.R.M. Grovenor, S.C. Speller, P. Kováč, L. Kopera, I. Hušek, Comparison of interfacial and critical current behaviour of Al+ Al_2O_3 sheathed MgB_2 wires with Ta and Ti diffusion barriers, Journal of Alloys and Compounds, Volume 807, 2019, 151665.
4. L Kopera, P Kováč, J Kováč, T Melišek, I Hušek and D Berek, Small diameter wind and react coil made of anodised Al-sheathed MgB_2 wire, Superconductor Science and Technology, Volume 32, Number 10, 2019.
5. P Kováč, L Kopera, J Kováč, T Melišek, W Haessler, D Wang and Y Ma, Current densities and strain tolerances of filamentary MgB_2 wires made by an internal Mg diffusion process, Superconductor Science and Technology, Volume 32, Number 9, 2019.

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