# Development of Cu/Ta sheathed Ca/K-1144 wires for fusion applications

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Low-temperature and high magnetic fields conditions such as those characterizing fusion reactors represent the optimal playground for Iron-based superconducting materials, with compounds exhibiting extremely high critical magnetic fields and currents in such conditions. Moreover, the possibility of developing wires and tapes with highly scalable and cost-effective Powder in Tube techniques has been demonstrated for several compounds. Among these, the best results have been obtained with members of the 122 family of iron-based materials, adopting a silver sheath that encases the powders, with recent results showing their potential at fields above 30 T. The choice of silver as diffusion barrier involves however some limitations in terms of processing variables and chemical components of the superconducting compound.

As a different experimental approach, we are evaluating the development of Cu/Ta composite sheaths coupled with Ca/K-1144 materials [1]. Our previous results show the potential of this choice, demonstrating good chemical compatibility within a large temperature window. The approach shows however critical points, related to the fragility of the tantalum diffusion barrier towards harsh mechanical treatments [2].

In order to enhance critical currents of the Cu/Ta based Ca/K-1144 wires, several aspects are to be tackled. The powder morphology shows a crucial role for effective texturing during the mechanical treatment: novel synthesis approaches are evaluated to enhance crystallinity of the powders in a simple and scalable process. Optimization of the sintering treatment, considering the combination of pressure, time and temperature, is also necessary to minimize granularity and weak links. The chemical composition of the superconducting compound is as well observed to play a role in defining the high field properties [3], [4], and the role of different substituents in the Ca/K-1144 compound is evaluated. All these aspects are here described and discussed, reporting novel experimental results on wires obtained with the Cu/Ta composite-based architecture.

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**References** (Times New Roman 10 pt)

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