Nitride compounds: new superconductors from a still little-investigated world

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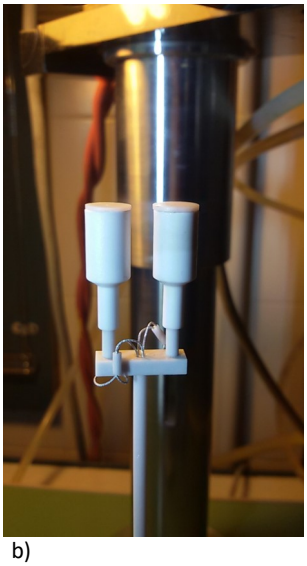
Project objectives

a)



b)

The superconductors play crucial roles for both the fundamental science and technological applications, as they hold great promise in addressing our global energy sustainability. The major challenge is to find new superconducting materials with higher Tc (as high as possible). The high-temperature superconductivity constitutes an extremely important and challenging problem which, if solved, would have an important and enormous impact on the technological applications. The design of new superconductors has been and is nowadays one of the most ambitious and crucial goal of the scientific world. Lots of efforts have been made in order to discover new superconductors with higher Tc and Hc; the identification of new superconductors allows both to enhance the fundamental studies and knowledge concerning the mechanism(s) controlling this phenomenon and also to identify new candidates for possible technological applications. At this regard, the nitrides are a promising class of compounds to be investigated, as they represent a great opportunity for the discovery of not only new superconducting materials but also new semiconductors and magnets (either soft and hard). The nitrides are a “mine” of new compounds still unexplored.

The N-based compounds constitute an interesting and completely diverse class of inorganic compounds. They have remained relatively unexplored if compared to other materials. Even though during the last decades their number has greatly increased, it still remains rather low in respect to other classes of inorganic phases. Nitrides are interesting from both the perspective of basic science and industrial applications, because they adopt new crystal structures with unique and unusual stoichiometries and, at the same time, show physical properties singular and different from those of other materials. To date most of the research activity has been focused on simple binary nitrides and only a few ternary phases have been well characterized. The progress beyond the binary N-based systems has been hindered, till today, because of the difficulties in their synthesis and due to the limitations of analytical methods. Nowadays, very few laboratories worldwide own tools and potentiality necessary to study these compounds. Our team, having a long-lasting recognized knowledge and experience in the syntheses of materials, other than in their chemical and physical characterization, has the required skills to face with this research topic. Our competence, which is unique in Italy, already brought to excellent results within collaborations with local and outer industries.

Our goal in this project is to synthetize and characterize new ternary and multinary nitride compounds with improved superconducting properties, then try their use in thin-film depositions and production of superconducting cables. This project is part of a consolidated research program that the Institute SPIN-CNR is carrying out in the field of superconductivity. The action will assemble a network of specialists from several local institutions, which will work cooperatively and in a coordinated way with the common aim to develop innovative N-based superconducting materials.

Figures:
Differential thermal analysis (DTA) heads, with alumina (a) or sealed Mo crucibles (b), to study thermal effects in new materials".