Communication

Discussion on the Properties of ThS's Room-Temperature Superconductivity

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Discussion on the Properties of ThS's Room-Temperature Superconductivity

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Abstract: This communication-style paper aims to address questions regarding our report on ThS's room-temperature superconductivity [1,2]. It arises from a conflict between our theory, known as "the Zhao theory," and an experimental result published by A. R. Moodenbaugh et al. in 1978 [3]. This communication concludes that the significant deviation between "the Zhao theory" and Moodenbaugh's work is due to differences in sample purity and crystallinity.

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Dear Editor,

I am writing to you to clarify a controversial issue about ThS's room temperature superconductivity. This issue came from our publication entitled "Room Temperature Superconductivity in Thorium Salts Reveals a Novel Superconducting Mechanism" in May 2024 [1]. In that paper, a theory, i.e., "the Zhao theory", about the way for a compound becomes a superconductor was illustrated. The basis behind this theory is twofold. First, the electrons on the conduction band are paired. Second, the paired electron are on a specific network of the compound that allows the paired electrons to travel or be delocalized on this network to form the supercurrent. The Zhao theory uses the compound's crystal structure to build a supercurrent network for electron pairs to flow and claimed that several thorium compounds meet the requirements. We developed this superconducting mechanism because we found these thorium compounds own such a unique property of coexistence of high electrical conductivity and diamagnetism at room temperature and ambient pressure. Taking into this exceptional electromagnetic property of coexistence of high electrical conductivity and diamagnetism along with their relevant crystal structures, we developed a mechanism of the superconductivity for these compounds and used "the Zhao pairs" and "the Zhao networks" to describe this unusual electron magnetic property along with claiming that compound with this property under ambient condition is actually a room temperature superconductor [2].

We also described an unfortunate situation on not being able to test the compounds' superconductivity at this moment because of the regulation imposed issue on obtaining the necessary starting materials for resynthesizing the relevant compounds for the verification work [1].

ThS is one of the compounds we illustrated in the paper to demonstrate our idea about the mechanism for a compound to be a superconductor at ambient condition [1]. However, several readers wrote to us and raised question about the ThS's room temperature superconductivity. This is because it was reported that ThS is a low temperature superconductor with T_c of about 0.5 K. This result was from an attempt on exploring ThS's superconductive property in 1978 [3]. Moodenbaugh, etc., reviewed superconductive properties for a group of NaCl structured salts. ThS was one of them that the ThS's T_c was reported only 0.5 K. This T_c of only 0.5 K is far from our claimed T_c of at least room temperature for ThS in our paper [1]. Now the question is what makes the big difference between our observatory based claim and the experimental result by Moodenbaugh?

Notice that the ThS sample described in Moodenbaugh's review is not a pure one because of the oxidation of thorium induced ThO_2 form existed in the sample and in addition with obvious phase inhomogeneity. In other words, the 0.5 K of ThS' T_c was from an experimental result on a chemical

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impure and phase inhomogeneous sample. In our paper, we clearly stated that our new task should be to resynthesize a pure ThS samples and better to grow ThS into a single crystal for the experimental study on its room temperature superconductivity [1]. Compared to what we hoped, the sample used for Moodenbaugh's review may not be appropriate. Consequently, the work on verifying the ThS's room temperature superconductivity would be based on a chemical pure and phase homogenous ThS sample, better to be a single crystal piece, in order to approve or disapprove the Zhao theory.

References

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