Key compound for high-temperature superconductivity found

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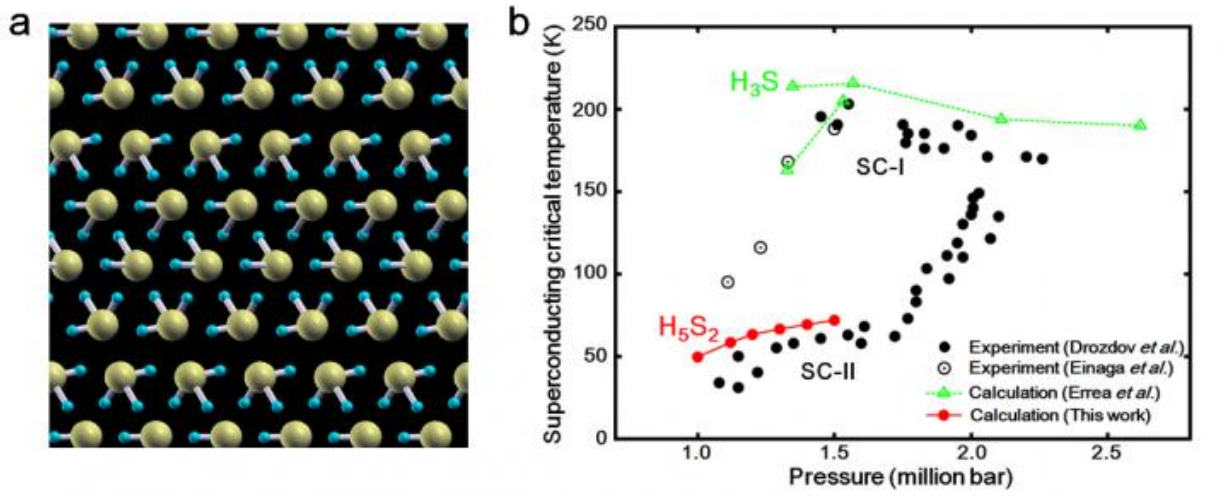

a. Crystal structure of the H5S2 compound predicted by genetic algorithm technique. The structure forms a mixed structure of H2S and H3S molecules. b. Comparison of superconducting critical temperature (Tc) among experimental and calculated results. The Tc value calculated for H5S2 shows a good agreement with the experimental data of the superconducting phase II (SC-II). Credit: Osaka University

A research group in Japan found a new compound H_5S_2 that shows a new superconductivity phase on computer simulation. Further theoretical and experimental research based on H_5S_2 predicted by this group will lead to the clarification of the mechanism behind high-temperature superconductivity, which takes place in hydrogen sulfide .

Superconductivity is the total disappearance of electrical resistance when an object is cooled below a definite temperature. If superconductor is used for electric wire, it becomes possible to carry electricity without loss. That's why superconductivity has been drawing attention as an important physical phenomenon for solving environmental and energy problems.

However, the superconducting critical temperature, the temperature at which superconductivity takes place, is so low that its practical realization is difficult. Last year, a striking news came out that H2S broke the record for superconducting critical temperature under high-pressure. However, the chemical composition ratio of sulfur and hydrogen and the crystal structure during the process in which superconductivity takes place have not been well understood.

A research group led by Takahiro Ishikawa, Specially Appointed Assistant Professor, and Katsuya Shimizu, Professor, at Center for Science and Technology under Extreme Conditions, Graduate School of Engineering Science, Osaka University, Tatsuki Oda, Professor at School of Mathematics and Physics, Kanazawa University, and Naoshi Suzuki, Professor at Faculty of Engineering Science, Kansai University predicted a new superconductivity phase of hydrogen sulfide (H_5S_2), which was presented at a pressure of 1.1 million bar on computer simulation. The superconducting critical temperature obtained from H_5S_2, whose calculated value was the same as the experimental value. This result may lead to the clarification of the mechanism behind high-temperature superconductivity, which takes place in hydrogen sulfide by further theoretical and experimental research based on H_5S_2.

Furthermore, by applying methods used and knowledge obtained by this group to other light element hydrides, it will become possible to establish guidelines for enhancing superconducting critical temperature to near room temperature.

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More information: Takahiro Ishikawa et al, Superconducting H5S2 phase in sulfur-hydrogen system under high-pressure, *Scientific Reports* (2016). DOI: 10.1038/srep23160