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Breakdown of the Kondo insulating state in SmB_6 by introducing Sm vacancies[1]

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We explore the stability of the hybridization gap in SmB_6 to presence of a small number of Sm vacancies typical for this material, and demonstrate the extreme fragility of the Kondo insulating state. For the most stoichiometric sample we detect the hybridization gap which appears below 50 K as a depressed electronic Raman intensity below about 30 meV. The spectral weight that shifts to higher frequencies on the opening of the hybridization gap, forms two electronic maxima at 100 and 41 meV. We assign these maxima to the excitations between hybridized $4f$-$5d$ bands using recent band structure calculations. Below 30 K, in-gap exciton modes with long lifetimes protected by hybridization gap develop at 16-18 meV. With the increase of the number of Sm vacancies the exciton features broaden, evidencing a decrease in the lifetime due to a presence of electronic states in the gap. When we reach a concentration of Sm vacancies of only about 1 only the most stoichiometric SmB_6 samples possess a bulk gap necessary for the topological Kondo insulator state.

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