Polytypism and superconductivity in the NbS_2 system

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NbS_2 is a metallic layered transition metal dichalcogenide. While the layers consist of covalently bound atoms, weak van der Waals forces hold the layers together. NbS_2 can have two different stacking sequences, resulting in two different stable polytypes: 2H- and 3R-NbS_2. We report on the phase formation and the superconducting properties in the NbS_2 system. Specifically, we have performed a series of standardized solid-state syntheses in this system, which allow us to establish a comprehensive synthesis map for the formation of the two polytypes 2H-NbS_2 and 3R-NbS_2, respectively. We show that the identification of two polytypes by means of X-ray diffraction is not always unambiguous. Our physical property measurements on a phase-pure sample of 3R-NbS_2, on a phase-pure sample of 2H-NbS_2, and a mixed phase sample confirm earlier reports that 2H-NbS_2 is a bulk superconductor and that 3R-NbS_2 is not a superconductor above $T = 1.75$ K. Our results clearly show that specific heat measurements, as true bulk measurements, are crucial for the identification of superconducting materials in this and related systems.