Dimensionality driven enhancement of ferromagnetic superconductivity in URhGe

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We report an experimental study applying uniaxial stress and magnetic field at very low temperature on the ferromagnetic superconductor URhGe. This system is famous for the co-existence of superconductivity and ferromagnetism at ambient pressure, but also for its remarkable phase diagram under magnetic field. When a field is applied along the b-axis, transverse to the easy magnetization c-axis, two separate pockets of superconductivity exist, one at low field, and a re-entrant superconducting phase appearing under field. Here we show that uniaxial stress can spectacularly modify the phase diagram, pushing the high field superconductivity pocket to lower fields so that it reconnects to the low-field superconducting phase. This implies that the field H_R where the magnetic moments rotate from the easy axis to align with the field is strongly suppressed by stress. Simultaneously superconductivity is significantly enhanced and the critical temperature at high field reaches 1K, twice higher than at ambient pressure, while the critical temperature at zero field also increases. This enhancement of superconductivity is directly related with the increase of the magnetic susceptibility perpendicular to the easy axis, and to a reduction of the ferromagnetic anisotropy. This provides novel input for theories of superconductivity in correlated ferromagnetic materials and many perspectives for future experimental studies.

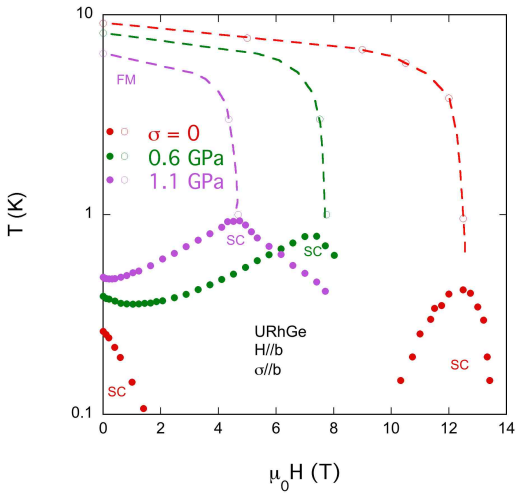

Figure 1 : Ferromagnetic and superconducting T-H phase diagram of URhGe for different values of uniaxial stress applied along the b-axis