Eliashberg theory and quantum confinement in superconducting thin films

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We have developed a microscopic theory of superconductivity in thin films, in quantitative parameter-free agreement with experimental data of the superconducting critical temperature vs film thickness of two distinct materials. In addition, the theory explains the markedly decreasing trend of the magnetic field penetration depth with increasing the film thickness. The novelty of the theory lies in the quantitative implementation of a quantum confinement model that allows one to account for the effects of film thickness on fundamental physical quantities, such as the Fermi energy, the density of states at Fermi level, and the impact thereof on the phonon-mediated Cooper pairing. This leads to new Eliashberg-type equations that directly incorporate the effects of film thickness.

References

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