From cuprate to iron-based superconductors - some key elements of high-temperature superconductivity

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Cuprate and the recently discovered iron-based high-temperature superconductors (HTSs) appear to have some features in common: 1) they have unusually high transition temperatures T_c, 2) they have layered structures with strongly anisotropic normal state and superconducting properties, 3) they exhibit a rich doping dependent phase diagram with coexisting or non-coexisting magnetic and superconducting phases (with the exception that for cuprates the undoped mother compound is an isolator, whereas in the iron-based systems the mother compound is metallic), 4) there exist hole doped and electron doped variants of these HTSs, 5) they show a pronounced isotope effect on T_c (for the cuprates isotope effects on various quantities, including the in-plane penetration depth and the pseudogap temperature, were observed, whereas in iron-based compounds at present controversial results have been reported for the isotope effect on T_c), and 6) they are multi-band superconductors with (eventually) mixed order parameters. In this talk some common and unlike properties of cuprate and iron-based HTSs will be discussed and also compared to those of the non-magnetic layered two-band superconductor magnesium diboride. Furthermore, it is shown that pronounced lattice and multi-band effects are essential to achieve the high transition temperatures in the cuprate and iron-based HTSs.