Electron Screening in Metals

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Electron screening enhances cross sections for nuclear reactions at low energies. Exceptionally large electron screening has recently been observed when the reactants were implanted in various metals. We have studied the $^{1}H(^{7}Li,\alpha)^{4}He$ reaction in inverse kinematics and observed large electron screening only when the metallic targets were under tensile stress [1]. Hydrogen was loaded into Pd and PdAg alloy foils from gas phase and concentrations reached about 0.6 protons per metallic atom. Mechanical pressure creates stress induced states in the metal. Without pressure hydrogen occupies octahedral interstitial positions in the fcc Pd lattice. Under stress some protons move to dislocated octahedral (dis-O) sites in the lattice [2]. Incidentally, these dis-O sites may be the same as those, where hydrogen ends up after implantation [2]. As opposed to our experiment almost all previous electron screening studies in metals have been performed on implanted targets (see [1] and refs. therein). We believe that the magnitude of screening in various metals depends on the electron density on dis-O sites in case of fcc lattices or dislocated tetrahedral sites in bcc metals. In case of gas loading of hydrogen, the fitted value of the screening potential also depends on the portion of protons occupying the dislocated sites. We are currently trying to confirm the above claims by determining the electron density at the sites occupied by protons via the measurement of proton Knight`s shift with ^{1}H nuclear magnetic resonance technique and by calculating spatial distribution of electrons in the crystal.

[1] M. Lipoglavsek *et al*., Eur. Phys. J. **A44**, 71 (2010).
[2] Y. Fukai, The Metal-Hydrogen System, Springer, Berlin, Germany, 2005.