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Understanding materials based on the electron work function

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Abstract

Properties of materials are fundamentally dependent on their electron state that governs the atomic and molecular interactions, which consequently affect their performance during various mechanical, physical and chemical processes. The electron behavior is largely reflected by the electron work function, which is the minimum energy required to move electrons at the Fermi level inside a material to its surface. With this simple characteristic parameter, many material intrinsic properties and processes could be analyzed without involving complex theoretical treatments. Not only helps understand the origins of material properties and relevant phenomena on an electronic base in simple ways, this characteristic parameter also provides complementary clues for new material design.

In this talk, the correlation between the electron work function of materials and their mechanical, electrochemical and physical properties will be demonstrated with a number of experimental observations. Sample applications of the electron work function in fundamental understanding the performance of conventional and nanostructured materials will be discussed with case studies, including mechanical properties of metals, corrosion behavior, interfacial bonding and tribological phenomena, surface nanocrystallization for bacterial biofilm control, nanocrystallization for enhanced resistances to corrosion and wear, and issues related to solar energy conversion efficiency of photocatalytic TiO2 nanotubes.

Biography

Dr. D.Y. Li is a professor at department of Chemical & Materials Engineering and an adjunct professor at the department of Biomedical Engineering, University of Alberta. His research interests include surface science and engineering, tribology and materials, computational materials science, photocatalysts, and bacteria-metal interfaces. Dr. Li has more than 250 publications including in excess of 200 refereed journal publications. Dr. Li is the editor-in-chief of the International Journal of Nano & Biomaterials and a member of editorial board for seven other journals in areas of materials, tribology, wear, and corrosion.