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Abstract for an Invited Paper  
for the MAR11 Meeting of  
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**Davisson-Germer Prize in Atomic or Surface Physics Talk: Soft X-Ray Studies of Surfaces, Interfaces and Thin Films: From Spectroscopy to Ultrafast Nanoscale Movies<sup>1</sup>**

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My talk will review the development of soft x-ray spectroscopy and microscopy and its impact on our understanding of chemical bonding, magnetism and dynamics at surfaces and interfaces. I will first outline important soft x-ray spectroscopy and microscopy techniques that have been developed over the last 30 years and their key strengths such as elemental and chemical specificity, sensitivity to small atomic concentrations, separation of charge and spin properties, spatial resolution down to the nanometer scale, and temporal resolution down to the intrinsic femtosecond timescale of atomic and electronic motions. I will then present scientific breakthroughs based on soft x-ray studies in three selected areas: the nature of molecular bonding and reactivity on metal surfaces, the molecular origin of liquid crystal alignment on surfaces, and the microscopic origin of interface-mediated spin alignments in modern magnetic devices. My talk will also cover the use of soft x-rays for revealing the temporal evolution of electronic structure, addressing the key problem of “function,” down to the intrinsic femtosecond time scale of charge and spin configuration changes. As examples I will present the formation and breaking of chemical bonds in surface complexes and the motion of the magnetization in magnetic devices.

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