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John C. H. Spence's Career-Long Impact on me as his Early Graduate Student

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It was my great fortune and pleasure to be an early MSc and then PhD student of John C. H. Spence. His mentoring, supervision and research collaborations with me were core to a successful career in industrial materials and sensing sciences. Following a thorough introduction to optical physics and mathematical methods, we pondered together a broad, nearly bewildering gamut of possible thesis topics. These spanned interference spectroscopy for inelastic scattering, neutrino mass experiments, new atomic resolution electron scattering studies, and finally electron energy loss spectroscopy in solids along with a linear combination of atomic orbitals approach for modelling main features of near edge fine structure dependency on bonding configuration. My graduate student colleague Harry Kolar recalls similar adventures developing his PhD thesis in HREM of silicon, which later contributed to him becoming an IBM Fellow. A joyous commencement photo with advisor Spence present along with my mother from 1984 is in Figure 1. This thesis research resulted in a Physical Review B publication that summarized the results and continues to be referenced today [1]. John's spirit and drive permeated my career. His presence was felt during high points of developing fundamental new approaches, discovery, leadership communication, mentoring and ultimately innovation and impact after applying his lessons.

John's fundamental approach to optics, diffraction, HREM, spectroscopy and novel ways to look at the physics enable strong scientific studies. As an example from applying spatially resolved EELS in catalysis, Figure 2 shows the main finding of a collaboration with UIUC on strong metal-support interactions (SMSI) [2]. This helped engage more of academic STEM research in catalysis, and showed that near-edge fine structure could indicate reduction of a support oxide near metal particles. This is of continued importance in catalysis for the energy transition including emerging hydrogen production methods. As an innovator, John conveyed to everyone a strong passion for finding the right problems, pursuing them with heroic effort, and in many cases bringing them to full application and innovation. For HREM imaging, with Gatan, John developed one of the first practical image-intensified video cameras for TEM, paving the way for aberration-corrected imaging and eliminating use of photographic plates. This often involves forming teams as in John's ground-breaking XFEL work. Similarly, at ExxonMobil, we advanced ultrasonics for communication and sensing in oil and gas wells [3].

From his many presentations, papers and books, John Spence was a phenomenal story-teller, "interest-grower" and communicator, who led by inspiring others to join complex projects to great academic and society-improving effect. An example from polymer blend morphology involved a 3D model of catenoid lamellar phase using tapered holes in plexiglass sheet [4]. This was in a significant way stimulated by story-teller John using a ruler slid over the multiple vent slots on a room heating vent to illustrate x-ray *juttering* in an early stage of his synchrotron work. As a mentor and supervisor, John focused on helping earlier scientists navigate complex and opaque research topics. Many mistakes were made, but these were always met by Prof. Spence with great humor and kindness. Joint research with John brought to all efforts a pervasive feeling of importance and enthusiasm that made the intense efforts possible, and in many cases successful. He helped many scientists in practical, unspoken ways. An example was in my job search that led to a staff position with Exxon, Spence provided a 9-point hand written list on selecting an employer including finances, who decides salary, promotion, health, "grounds for dismissal", and retirement. It is certain this same jovial yet driven approach brought numerous fruits across John's career, culminating in his tremendous contributions in fundamental biosciences and significantly reducing the size of x-ray free electron lasers. This naturally supportive yet questioning approach had dividends in my career while leading teams in sensing and developing emerging science/evaluating emerging energy systems from photovoltaics to carbon storage.

Figure 1. Olga Disko, Mark Disko and John C. H Spence at Arizona State University Commencement December 1984 where Mark received PhD for research under John on EELS near-edge fine structure.

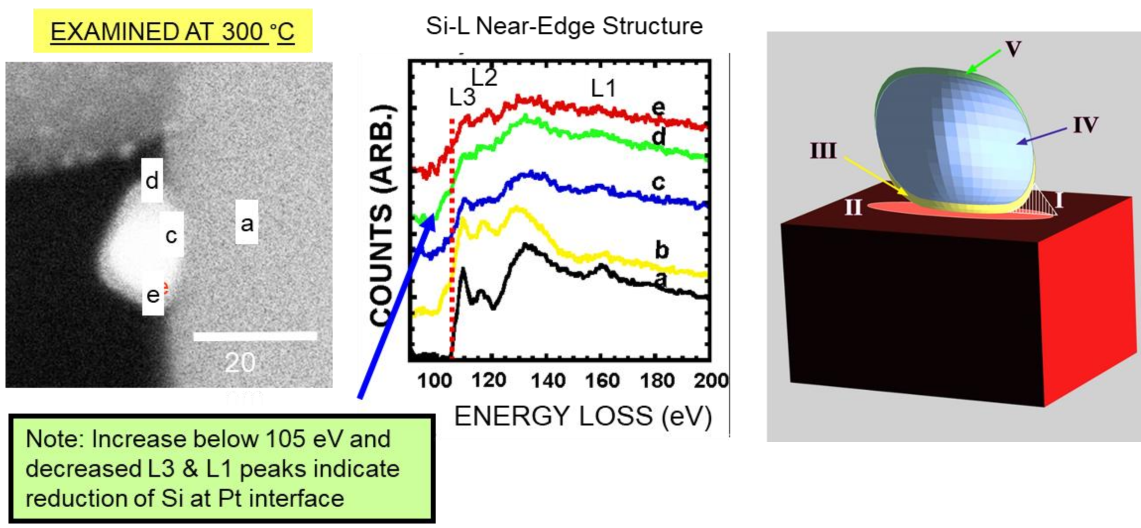

Figure 2. Platinum metal on silica model catalyst for examining strong metal-support interaction phenomena. At elevated temperature near the Pt – SiO_2 interface lower energy L3 transitions indicative of reduced silicon oxidation state are evident (spectra c, d, e). The work defined regions of interest in vicinity of an active metal particle on support (I – V) for SMSI phenomena in illustration at right.

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