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Structural and Electronic Correlations in Hybrid Materials: Perovskites under Pressure and O\textsubscript{2} Binding Metal–Organic Frameworks

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Understanding and controlling relationships between structural and electronic properties in materials enables their application toward important energy-related problems. Hybrid organic-inorganic materials, in particular, are attractive as highly tunable systems that can combine the strengths of molecules and extended solids. Here, I will detail research efforts in hybrid materials chemistry that are linked by this common theme of fundamental understanding and experimental control of structural and electronic correlations. I will illustrate how pressure—a valuable tool for modifying thermodynamic and transport properties—can engender dramatic compression-induced structural changes in halide perovskites, thereby altering and enhancing their electronic behavior. I will also describe how chemically reduced iron-pyrazolate metal–organic frameworks are capable of strong and selective adsorption of O\textsubscript{2} over N\textsubscript{2} at ambient (25 °C) or even elevated (200 °C) temperature, despite featuring coordinatively saturated iron centers.