LASER SPECTROSCOPY OF COINAGE-METAL CARBIDES FOR OPTICAL CYCLING, QUANTUM CONTROL, AND CATALYTIC INSIGHTS

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A recent triumph of physical chemistry has been to trap molecules at ultracold temperatures (<0.001 K) in "beakers" made of laser light. It is hoped that this will enable advances in quantum information science, precision measurement, and ultracold chemistry. Currently, the applicability of these techniques is limited to a very small subset of molecules, generally comprising an alkaline-earth atom bonded to a halogen-like ligand. We will discuss efforts at Williams College to identify new, complex molecules that can be cooled and trapped. This includes molecules built from coinage-metal and carbon-group atoms, CuX, AgX, and AuX (X=C, Si, Ge, Sn, and Pb). These molecules offer new handles for control and manipulation that stem from their chemical complexity. Excitingly (and unexpectedly), this work is also relevant to fundamental understanding of organic catalysis due to gold's utility in activating C-C double/triple bonds. We are thus preparing to perform spectroscopy of AuCC and AuCCH, nature's simplest models of gold-alkyne interaction.