Tuesday, February 20, 2018, 12:30 pm
Seaver Science Library, Room 150
SSC Auditorium next to the library

Professor Christopher Cummins

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Phosphorus-Element Bond-Forming Reactions

Abstract:

White phosphorus (P_4) has been the traditional entry point into phosphorus chemistry. The thirteenth element to have been isolated, it can be oxidized with elemental oxygen or chlorine, or reduced in a variety of ways. We investigated its reduction using early transition metal systems and breakdown to produce complexes with terminal metal-phosphorus triple bonds. Such terminal phosphide complexes possess nucleophilic phosphorus atoms, paving the way to new phosphorus-element bonded systems. This opened the door to the study of reactive diphosphorus molecules, the naked P_2 molecule being otherwise a high-temperature species. Subsequently, it proved possible to deliver P_2 into organic molecules using photochemical "cracking" of white phosphorus, the P_2 serving as an effective dienophile with 1,3-dienes. An alternative pathway to the generation of unsaturated, P-containing reactive intermediates is through the use of anthracene as a delivery platform as illustrated for aminophosphinidenes, the interstellar molecule HCP, and diphosphorus. The raw material serving as a phosphorus source for global agriculture is not white phosphorus, but, rather, apatite in phosphate rock. White phosphorus is made in the legacy "thermal process", accounting for ca. 5% of global phosphate rock consumption but ca. 30% of the energy utilized in phosphate rock upgrading. Now we are seeking routes to value added phosphorus chemicals that leverage the "wet process," in which phosphate rock is treated with sulfuric acid en route to phosphoric acid and phosphate fertilizers.

Hosted by Professor Smaranda Marinescu

The scientific community is invited

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