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INVITED LECTURE - The unique chemical and physical properties of the heaviest elements in the Periodic Table

Tuesday, 18 September 2012 09:00 (30 minutes)

The unique role of the heaviest elements in chemical and physical sciences is discussed. With the actinide series (Z = 90 –103) and the superactinide series (Z = 122 –155), the heaviest elements have significantly shaped the architecture of the Periodic Table of the elements. Relativistic effects in the electron shells of the heaviest elements change the chemical properties in a given group in a non-linear fashion. Relativistically stabilized sub-shell closures give rise to a new category of elements in the Periodic Table: volatile metals. The prototype for this property is element 114 which, due to the relativistic stabilization of its 7s27p1/22 electron configuration, is volatile in its elementary state, but, in contrast to a noble gas, exhibits a marked metal-metal interaction with a gold surface at room temperature. Nuclear shell effects dominate the physical properties of the transuranium elements. These give rise to superdeformed shape isomers (fission isomers) in the actinides (U –Bk). Superheavy elements (Z ≥ 104) owe their existence solely to nuclear shell effects at N = 152, 162, and 184. At this time, a building lot is the location of the next spherical proton shell closure as there is evidence that the center of the "island of stability"is not at Z = 114. This needs urgently further theoretical and experimental efforts. The cross sections for the syntheses of elements 119 and 120 will give us important information on the "upper end of the Periodic Table of the elements".

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