In principle, the unpaired electron in a molecular radical should be capable of serving as a charge carrier. Accordingly, a chain of interacting radicals $R$, each with one unpaired electron, would possess a half-filled ($f = \frac{1}{2}$) electronic energy band, just like an array of atoms in an elemental metal such as sodium. The Achilles heel of the model lies in the fact that there is an intrinsically high onsite Coulombic barrier $U$ to charge transfer for any $f = \frac{1}{2}$ system. Overcoming the charge repulsion barrier requires that intermolecular charge transfer integrals $t$, and hence the electronic bandwidth $W(= 4t)$, be sufficiently large to offset $U$. When $W > U$, the Mott-Hubbard gap $\Delta E$ vanishes, and a metallic state should prevail.

However, generating radicals in which $W$ is large and $U$ small is a major synthetic challenge. Our approach is to focus on heavy atom (sulfur and selenium) heterocyclic radicals. The presence of the heavy (soft) heteroatoms and a highly delocalized spin distribution lowers the value of $U$, while the enhanced intermolecular interactions afforded by the spatially extensive S/Se valence orbitals increases $W$. Magnetic exchange interactions and magnetic anisotropy is also increased. While physical pressure affords increased bandwidth and improved conductivity, the use of chemical pressure, sculpting radicals to allow a high density solid state packing, has led to some remarkable materials which approach the Mott insulator to metal phase transition.