Molecular Surgery via C—H Oxidation

Site-selective, catalytic C—H oxidation reactions for broad use in organic synthesis will be discussed. Catalysts have been developed that enable atomistic changes in complex molecules transforming C(sp3)—H bonds to C(sp3)—O, C(sp3)—N, and C(sp3)—C under preparative conditions with predictable and catalyst-controlled site-selectivities- without the requirement for directing groups. The reactions and quantitative models developed to understand and predict site-selectivities for aliphatic C—H hydroxylations will be discussed. Collectively this understanding has provided fundamental insights into the physical organic properties of C—H bonds that govern their differential reactivity in complex molecules. These reactivity principles have been demonstrated in other C(sp3)—H reactions. The generality of these reactions have led to strategic advances synthesis, most notably the concept of late-stage C—H functionalization.