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(54) **Title:** HYDROGENATION AND DEHYDROGENATION CATALYST, AND METHODS OF MAKING AND USING THE SAME

(57) **Abstract:** The present application discloses complexes useful as catalysts for organic chemical synthesis including hydrogenation and dehydrogenation of unsaturated compounds or dehydrogenation of substrates. The range of hydrogenation substrate compounds includes esters, lactones, oils and fats, resulting in alcohols, diols, and triols as reaction products. The catalysts of current application can be used to catalyze a hydrogenation reaction under solvent free conditions. The present catalysts also allow the hydrogenation to proceed without added base, and it can be used in place of the conventional reduction methods employing hydrides of the main-group elements. Furthermore, the catalysts of the present application can catalyze a dehydrogenation reaction under homogeneous and/or acceptorless conditions. As such, the catalysts provided herein can be useful in substantially reducing cost and improving the environmental profile of manufacturing processes for variety of chemicals.

