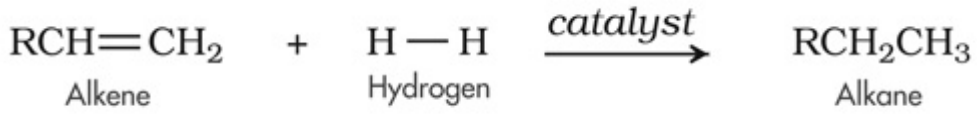
3.6. HYDROGENATION

Unsaturated alkenes can be converted into saturated alkanes by the addition of hydrogen atoms across the double bond. This reaction is usually catalyzed by a nickel or platinum catalyst, and the hydrogen is usually added in the form of diatomic hydrogen gas:



Pt, Pd or Ni

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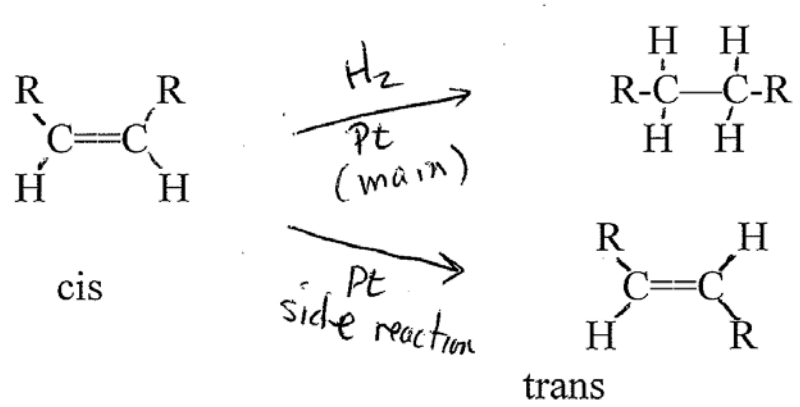
Hydrogenation reactions are carried out on a variety of food molecules but particularly vegetable oils. Margarine, vegetable shortening and a majority of bakery products (crackers, cookies, pies, chips) contain partially hydrogenated vegetable oil. The vegetable oils are hydrogenated in order to raise their melting point above room temperature. Thus hydrogenating vegetable oils converts them into solids at room temperature. This is convenient, since it allows vegetable oils to be converted into such products as Crisco, margarine, etc. (In fact margarine is just Crisco with some food coloring and food flavoring added.)

Small amounts of finely powdered Pt (platinum), Pd (palladium) or Ni (nickel) are added as catalysts to catalyze the hydrogenation of polyunsaturated oils. Manufacturers of partially hydrogenated vegetable oils do not attempt to hydrogenate **all** the double bonds in margarine: this would produce a hard brittle fat. They add enough hydrogen to partially hydrogenate the polyunsaturated vegetable triglycerides, leaving some of the double bonds in the triglyceride. This turns the oil into a soft solid, with melting point just slightly above room temperature. It was noticed many years ago that the metal catalysts act to catalyze the conversion of cis double bonds into trans double bonds on the unhydrogenated double bonds. Nearly all of the double bonds found in naturally occurring triglycerides are cis (i.e. the chain comes in and leaves the ring on the same side of the double bond). The presence of the Ni or Pt metal causes a cis-trans isomerization on many of the double bonds that do not get hydrogenated.



Thus margarine contains a significant number of trans double bonds which are not found in nature. There have been many studies done on the health ramifications of the presence of trans double bonds in partially hydrogenated fats. The consensus of most studies is that triglycerides containing trans double bonds increase the risk of atherosclerosis and coronary heart disease (CHD) even more than saturated triglycerides. This is rather ironic, since one of the selling points used by margarine manufacturers for years has been that margarine is less saturated than butter and hence reduces the risk of atherosclerosis compared with butter.