Hydrogen as a Carrier gas in GC QQQ

There are a number of factors that must be considered when switching from helium to hydrogen as a carrier gas in mass spectrometry.

The first issue is that hydrogen is a reducing agent and it will ‘scrub’ the system. This includes the carrier gas lines, traps, GC and MS. The initial effect is a higher than normal background or noise in the system. Generally speaking it may take weeks or even months for the scrubbing the system depending upon the initial conditions.

Using hydrogen as a carrier will generally create higher (M+H) + ions. Since most of the standard mass spectral libraries were developed with helium as a carrier gas, library matching algorithms may be adversely affected leading to poor match quality and possibly false positives (or negatives).

Hydrogen may also have an adverse effect on the gas phase chemistry occurring in source. For example, the 17 keto steroids are reduced to the corresponding alcohols. Hence this may influence quantitation of this class of compounds.

Another potential problem with using hydrogen as a carrier gas is with halogenated solvents. In one particular study (Agilent internal), when methylene chloride was used as a solvent at inlet temperature above 275 degrees C the presence of hydrochloric acid, HCl, was found to be present. The increased HCl led to ghost peaks and many polysiloxane peaks attributed to column degradation. The conclusions of this study were to keep the inlet temperature below 250 degrees C to minimize the formation of HCl, wash all inlet parts with methylene chloride prior to use and be prepared for rapid column degradation.

When changing directly from helium to hydrogen lower inlet pressures are observed to maintain the optimum linear velocity. Typically to counteract this effect, smaller id columns are used. The impact of this may be smaller or lower loading on the column. However the increased selectivity of the narrower column, may give better resolution and hence higher peak intensity thus counteract a lower pumping capacity (see below).
The smaller more energetic hydrogen molecules present difficulties for the typical vacuum systems. Depending upon the pumping efficiency and flow rates of hydrogen, the increased pressure in the mass spectrometer may reduce the sensitivity of the analysis. However this effect may be compensated for the increased resolution in the chromatography as mentioned above.

Also a point needs to be mentioned about the potential safety concerns with hydrogen as a carrier. It is well established that it is a potential explosion hazard. Please see G3170-90010_051263.pdf.

Another factor that must be considered when using hydrogen as a carrier is the quenching gas in the collision cell. Helium is introduced in the collision cell to reduce the number of helium meta stable ions reaching the detector and introducing noise. In the situation where hydrogen is used as a carrier, it is advised to remove the helium quench gas and securely cap off the helium quenching line to the collision gas.

Although the use of hydrogen as a carrier gas may increase sample throughput, it may have additional undesirable effects on the analysis. Any transfer of methodology may require considerable method development—not to say it can’t be done, but there are a number of factors that must be considered. An additional reference may be http://www.chromatographyonline.com/lcgc/article/articleDetail.jsp?id=653133.