Role of Ortho- to Para- Hydrogen Conversion in Hydrogen Liquefaction

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Hydrogen is an energy carrier and produced just like electricity. At present, pure hydrogen is being liquified prior to transportation particularly over long distances. Hydrogen molecule exists in two different forms distinguished by the orientation of its nuclei spin, which results in slightly dissimilar properties. At 25 °C, molecular hydrogen consists of 75% ortho-hydrogen, with nuclei spin in same direction, and 25% of para-hydrogen, with nuclei spin in the opposite direction; it is commonly referred to as normal hydrogen. Quantitatively, at 20 K, the enthalpy of o-p conversion is ~527 kJ/kg while the heat of vaporization of p-hydrogen is ~447 kJ/kg, which makes the conversion to para form an exothermic affair. From liquefaction point of view, this enthalpy of conversion is an additional cooling duty that enhances the total reversible work by about 15%.

This work was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2018R1A2B6001566) and by Priority Research Centers Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2014R1A6A1031189).