Novel Metal Membranes Permeable only to Hydrogen

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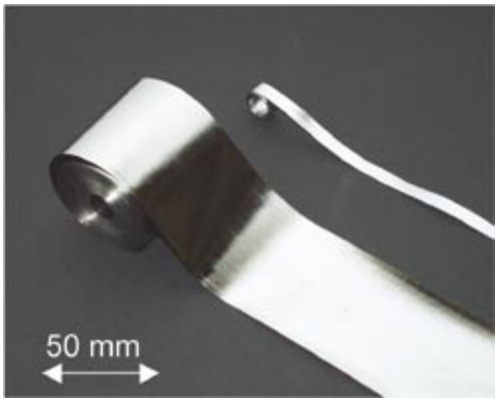
Palladium membranes are permeable only to hydrogen. Producing high purity hydrogen by means of such membranes and feeding it to fuel cells as fuel, the energy efficiency of fuel cells can be improved. However, palladium is extremely expansive. We have, therefore, looked for new membrane materials to find that amorphous $Zr_{36}Ni_{64}$ alloy membranes have a practical level of hydrogen permeability and good mechanical properties even in a hydrogen atmosphere. Moreover, we have developed various amorphous alloy membranes including amorphous $Zr_{60}Ni_8Al_{15}Cu_{15}Co_2$ with a high permeability comparable to palladium. Since 2003, we have been developing a prototype of hydrogen production system using amorphous alloy membranes in METI's regional consortium project. We have already succeeded to produce amorphous alloy membranes as wide as 50 mm, using which we have successfully demonstrated hydrogen separation from gas mixture containing carbon monoxide and carbon dioxide.



Amorphous alloy membranes quenched from the melt by courtesy of MITSUBISHI MATERIALS CO.

Time series measurement of CO_2 in the Western North Pacific

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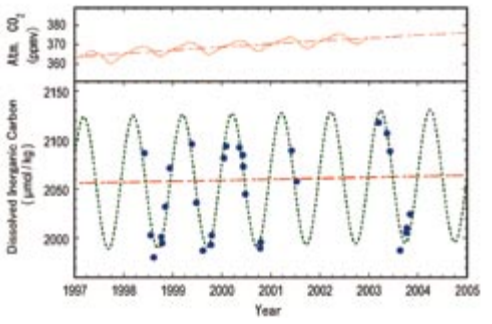
Carbon dioxide concentrations in the surface seawater have been determined in the Japanese ocean time series program at station KNOT (155°E, 44°N). The seasonal amplitude of dissolved inorganic carbon was more than 100 μmol/kg (Figure), mainly due to biological uptake in summer and strong vertical mixing in winter. As a result of these large changes, surface fugacity of carbon dioxide was lower than the atmospheric value in summer and autumn, and oceanic absorption of carbon dioxide was largest in autumn when the wind velocity started to increase. The increase rate of carbon dioxide in the surface seawater was estimated at about 1 μmol/kg/year.



Time series of CO_2 in concentration in the atmosphere at Hawaii Maunaloa and in the surface seawater at station KNOT