Meso-nickel manganese oxide for the hydrogen peroxide decomposition

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As new infectious diseases increase recently, effective sterilization technique development has been important. Vaporized hydrogen peroxide sterilization is appropriate method for this objective because hydrogen peroxide is safer than ethylene oxide which is mainly used in vapor sterilization in terms of carcinogen and higher safe limit. But the hydrogen peroxide sterilization requires long running time, so efficiency have to be increased by reducing the time for effective sterilization. Aeration step, reducing hydrogen peroxide concentration to 1 ppm due to harmful beyond this level, has a large portion of total time. Thus, developing a catalyst for the hydrogen peroxide decomposition is necessary to shorten the aeration time.

Manganese oxide is a representative catalyst for the hydrogen peroxide decomposition because hydrogen peroxide decomposes by transition metal's reversible oxidation state change. But bulk manganese oxide has a low specific surface area, which results in a low catalytic activity. So developing a large specific surface area MnO_2 is essential for the hydrogen peroxide decomposition.

Hard template, also called nanocasting, is effective method for mesoporous metal oxide synthesis. Using mesoporous silica template such as SBA-15 and KIT-6, mesoporous metal oxide has a high crystallinity and specific surface area. For example, there are many meso-manganese oxide for catalytic reaction (e.g. CO oxidation [1], NO selective catalytic reduction [2]) and they showed high activities.

Additionally, bimetallic oxide has low activation energy for the H_2O_2 decomposition due to the promoted electron exchange ability [3]. Thus mesoporous bimetallic oxide is expected as the high activity catalyst for the H_2O_2 decomposition.

In this experiment, mesoporous nickel manganese oxide was synthesized by using hard template for the hydrogen peroxide decomposition. Meso-nickel manganese oxide showed higher activity compared to meso-manganese oxide (Fig. 2). Further objective is finding a main factor in the hydrogen peroxide decomposition by varying Ni/Mn ratio of mesoporous metal oxide.

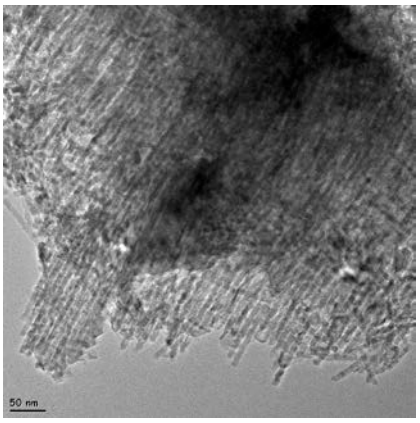

Fig. 1 TEM image of mesoporous manganese oxide

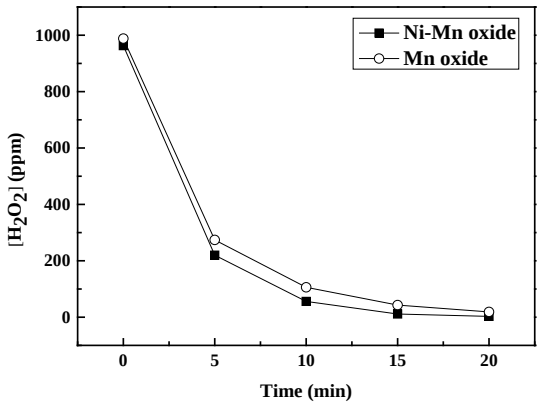

Fig. 2 Hydrogen peroxide decomposition
($[H_2O_2]_0$ = 1000 ppm, catalyst = 10mg, temperature = 25°C, 1200 rpm stirring)

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