# PHOTOCATALYTIC NITROGEN FIXATION ON SEMICONDUCTOR CATALYSTS

A Thesis presented by

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# ABSTRACT

The aim of this study is to develop the nitrogen reduction reaction based on solar energy and semiconductors. In this regard, several approaches were attempted and physical characterization studies such as band gap, flat band potential measurements, FTIR, DTA, XRD, EPMA and particle size analysis were used to characterize these materials.

Hydrated colloidal Mn (III) oxide was found to be an efficient catalyst for reduction of water. But it was not active for reduction of nitrogen. Hydrous Fe (III) oxide was reported to be a good catalyst for dinitrogen reduction and the preparation of the composite catalyst of $Mn_2O_3.xH_2O/Fe_2O_3.xH_2O$ showed higher catalytic activity than the individual hydroxides. The high catalytic activity of the composite catalyst is due to better charge separation and more negative flat band potentials.

Fine particles of Fe (III) oxide (FeOOH) formed by irradiating a solution of iron (II) bicarbonate were found to be photocatalytically active in the reduction of dinitrogen to ammonia. The catalytic activity is superior to the colloidal Fe (III) oxide. The high catalytic activity can be attributed to the small size of the particles where better interfacial charge diffusion and higher reduction potentials are possible.

It was found that Nafion films loaded with quantum sized particles of hydrous ferric oxide, immersed in aerated water at alkaline pH fix nitrogen, reductively and oxidatively at the same time. The microenvironment of the Nafion matrix supports the separation of excited species. The interesting feature of this catalytic system is the simultaneous production of ammonia and nitrite.

Niobium pentoxide doped either with $Fe_2O_3$ or $RuO_2$ at 1000°C was found to be an active catalyst for the photoreduction of nitrogen. Activity of these catalysts depend on the heating temperature and time, dopant amount, pH of the solution. It was found that the higher catalytic activity was closely related to the type of dopant and dopant amount.