

## Phase tuning of thermal plasma synthesized cobalt oxide catalyst and understanding of its surface modification during hydrolysis process of $\text{NaBH}_4$ .

Neha Ghodke<sup>a</sup>, S.V. Bhoraskar<sup>a</sup> and V.L. Mathe<sup>a\*</sup>

<sup>a</sup>Department of Physics, Savitribai Phule Pune University, Pune-411007, India

The XRD pattern of S1-S5 samples are depicted in Fig S1.

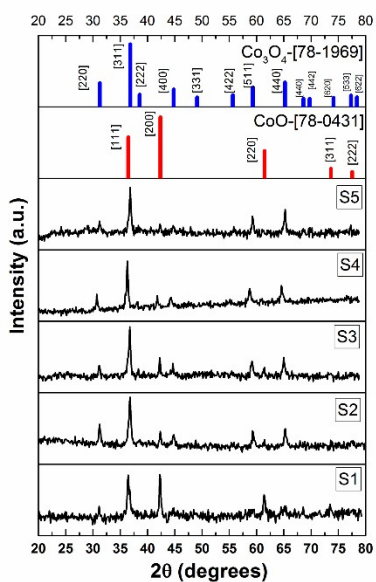


Fig S1:- XRD pattern of samples S1-S5 showing presence  $\text{Co}_3\text{O}_4$  and c-CoO phase with varied oxygen availability during reaction

The XPS survey spectra of S1 sample before catalysis, during catalysis and after catalysis are shown in Fig S2. The XPS survey spectra before catalysis process (Fig S2 a) show presence of Co, O and C species. However, as  $\text{NaBH}_4$  hydrolysis process continues (Fig S2 b-d), there is introduction of B and Na Species on the catalyst surface as observed.

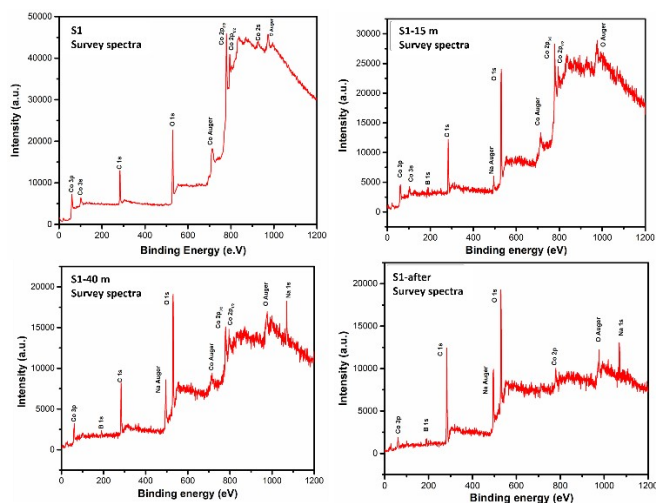


Fig S2: Survey spectra of sample a) S1 before catalysis; b) S1 after 15 min of catalysis process; c) S1 after 40 min of catalysis process; d) S1 after complete catalysis process

The XPS survey spectra of S4 sample before catalysis, during catalysis and after catalysis are shown in Fig S3. The XPS survey spectra before catalysis process (Fig S4 a) show presence of Co, O and C species. However, as NaBH<sub>4</sub> hydrolysis process continues (Fig S4 b-d), there is introduction of B and Na Species on the catalyst surface as observed.

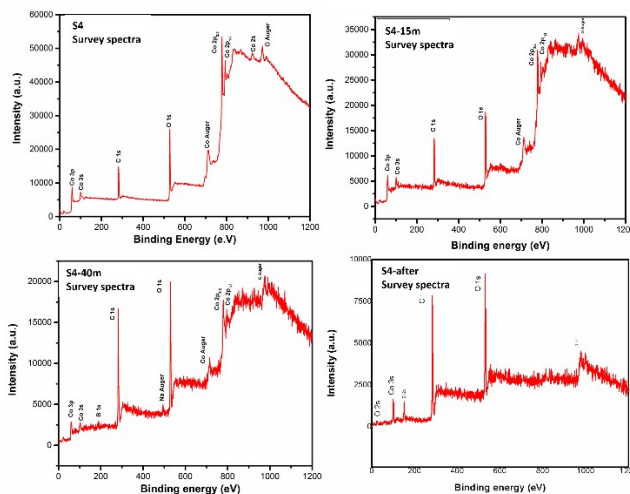


Fig S3: Survey spectra of sample a) S4 before catalysis; b) S4 after 15 min of catalysis process; c) S4 after 40 min of catalysis process; d) S4 after complete catalysis process

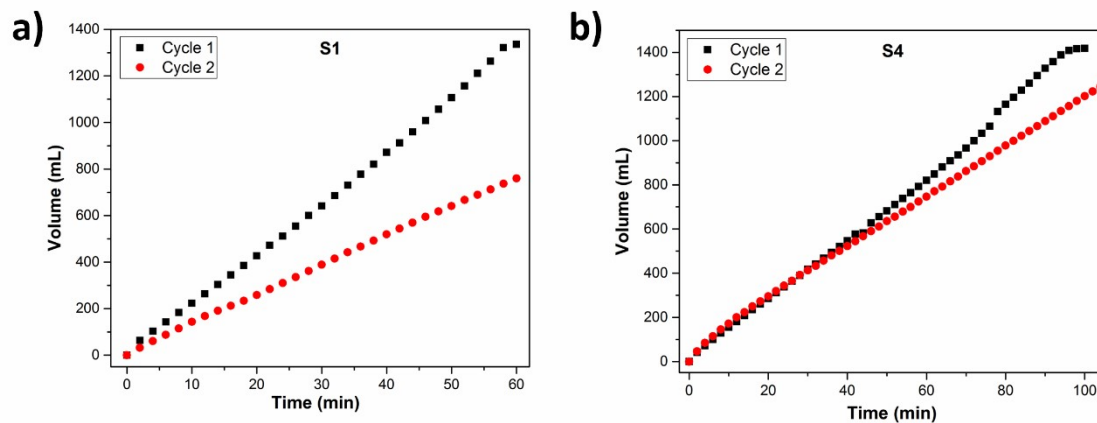


Figure S4:- Hydrogen produced in two subsequent cycles using a) S1 catalyst; b) S4 catalyst

The change in ratio of  $\text{Co}^{3+}/\text{Co}^{2+}$  does affect the recyclability of the catalyst. We have analysed catalytic performance for two subsequent cycles of catalyst S1 and S4 recorded for same reaction parameters i.e. 2000 mg  $\text{NaBH}_4$  at 10 pH 10 ml NaOH solution and reaction temperature of 302 K. For S4 catalyst, the second cycle does not alter much as compared to S1 catalyst.