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Hydrogen evolution from $NaBH_4$ using Pt nanoparticles supported on (2,2'-bipyridine) Cobalt (II) Titanoniobate nanocomposite.

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The excessive use of fossil fuels has increased environmental pollution through greenhouse gas emissions[1]. As a result, interest in sustainable energy alternatives is growing. Hydrogen (H_2) has emerged as a promising option, but its low density and boiling point make handling problematic, especially for storage and transportation. Hydrogen storage materials, such as sodium borohydride ($NaBH_4$), have become an alternative for H_2 evolution due to their commercial availability and high H_2 storage capacity[2]. In the present investigation, it was prepared platinum nanoparticles (Pt NPs) supported on (2,2'-bipyridine) cobalt (II) titanoniobate nanocomposite (CoTiNb) as a catalyst. $KTiNbO_5$ was used as the starting material for the production of $HTiNbO_5$. The latter compound was synthesized by suspending 10 g $KTiNbO_5$ in 100 mL 4 mol L^{-1} HNO_3 solution. The obtained $HTiNbO_5$ was dispersed in the distilled water, and then Bu_4NOH solution (0.297 mol L^{-1}) was added, forming $Bu_4NTiNbO_5$. After stirring for 7 days, a supernatant colloidal solution was collected, and then treated with $Co(bpy)Cl_2 \cdot XH_2O$ complex. The dispersion was stirred for 72h, forming a pink CoTiNb precipitate, Fig. 1(a) SEM image for CoTiNb can be observed. The CoTiNb was decorated with Pt NPs using the reduction method employing $NaBH_4$. The kinetics of $NaBH_4$ hydrolysis was investigated by varying different parameters such as Pt concentration, $NaBH_4$ concentration, NaOH effect and temperature; with which the activation energy (Ea) was calculated to be 48.52 kJ mol^{-1}, Fig. 1(b). The reusability of CoTiNb with Pt NPs was evaluated, obtaining an increase in the hydrogen generation rate (HGR) of 53.98% up to cycle 3, and the catalyst retained 61% of its original HGR after 10 cycles, Fig. 1(c). These results indicate that the Pt NPs supported on CoTiNb are promising for the $NaBH_4$ hydrolysis to generate H_2.

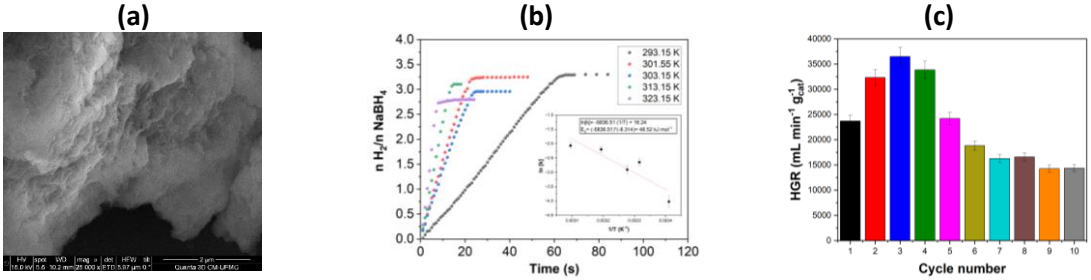

Figure 1. (a) SEM image for CoTiNb; **(b)** Effect of temperature on the volume of H_2 produced. Inset: Correlation between ln [k] versus 1/T; **(c)** Pt NPs supported on CoTiNb catalyst reuse cycles.

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