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**RESEARCH HIGHLIGHTS**

**1. Development of Non-precious Metal Catalyst Proton Exchange Membrane Fuel Cell (PEMFC)**

This research focus on seeking for cheaper materials to replace commercial precious platinum catalyst as oxygen reduction reaction (ORR) at cathode side of PEMFC. Material such as nitrogen-doped (N-Gr) or Iodine-doped graphene nanoplatelets could be potential candidates to synthesize them in a larger scale using simple preparation technique, ball milling.



FIGURE 1. Graphene suspensions from samples prepared at different ball milling speeds for 30 min. (1) at speed 100 rpm, and (2) at 50 rpm. Pictures taken for composite samples dispersed in DW after 1 sonication

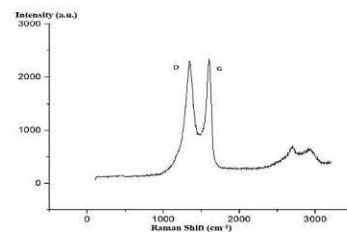


FIGURE 4. Raman spectra measured for (A) Sample A1 (1:1, 100 rpm) and Sample D2 (1:10, 500 rpm)

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N-Gr prepared by ball milling

D and G peak indicate the existing of N-Gr

**2. Development of Hybrid Proton Exchange PEMFC for Hydrogen Production Using Electrolysis of Copper Chloride-Hydrochloric Acid (CuCl-HCl).**

This research focus on development hybrid membrane for CuCl-HCl electrolysis with higher durability and lower copper cross over the membrane. Additionally, electrolysis at higher temperature (>100 °C) will promote higher hydrogen production. Polybenzimidazole (PBI) and Polyether ether ketone (PEEK) based membrane are type of potential materials to be used for this attempt to replace commercialized Perfluorosulfonic (Nafion®) membrane which is adaptable for lower temperature and facing copper cross over problem.

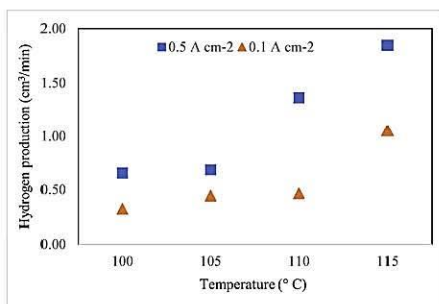


Fig. 8 – Effect of process temperature on hydrogen production for Nafion 117 at 0.5 A.cm<sup>-2</sup> and 0.1 A cm<sup>-2</sup> current density, 0.05 M CuCl.

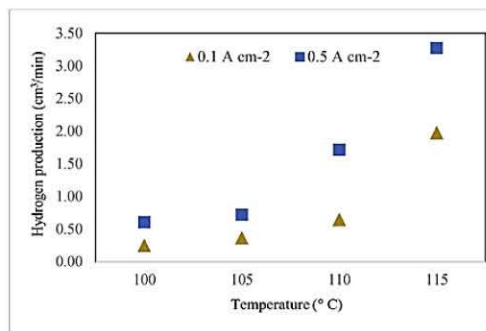


Fig. 9 – Effect of electrolysis temperature on hydrogen production for PBI/ZrP composite membrane at 0.5 A.cm<sup>-2</sup> and 0.1 A cm<sup>-2</sup> current density, 0.05 M CuCl.

Comparison of hydrogen production versus temp. between Nafion(®) and PBI based membrane

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