



**Industrial Consultancy & Sponsored Research (IC&SR)**

**PROCESS FOR PREPARING METAL FREE NITROGENOUS ORDERED MESOPOROUS CARBON MATERIAL AND ITS PRODUCT THEREOF**

**IITM Technology Available for Licensing**

**Problem Statement & Unmet Need**

- The commercial application of alkaline fuel cells is determined by the efficiency of oxygen reduction reaction (ORR) and on catalysts that promote these reactions
- Currently used platinum catalysts have sluggish kinetics, methanol crossover, high cost and limited availability.

**Intellectual Property**

- IITM IDF Ref. 2122
- IN410837 (Granted)

**Technology Category/ Market**

**Category – Manufacturing / Chemical**

**Applications** – Catalysis, separation and Energy Storage, Drug Delivery Systems, Diagnostics

**Industry-** Nanotechnology, Chemicals, Manufacturing, Medical

**Market** -The global microporous and mesoporous materials market size was USD 8,601.7 million in 2021. The market is projected to touch USD 14,930 million by 2028 exhibiting a CAGR of 8.2% during the forecast period.

**Key Features / Value Proposition**

**Technical Perspective:**

- ❑ Nitrogenous ordered mesoporous carbon as catalyst for oxygen reduction reaction in alkaline medium displaying superior activity and stability with a current density on par with 20% Pt/C commercial catalyst along with a four electron transfer and peroxide yield less than 10%.
- ❑ High surface area and uniform pore size

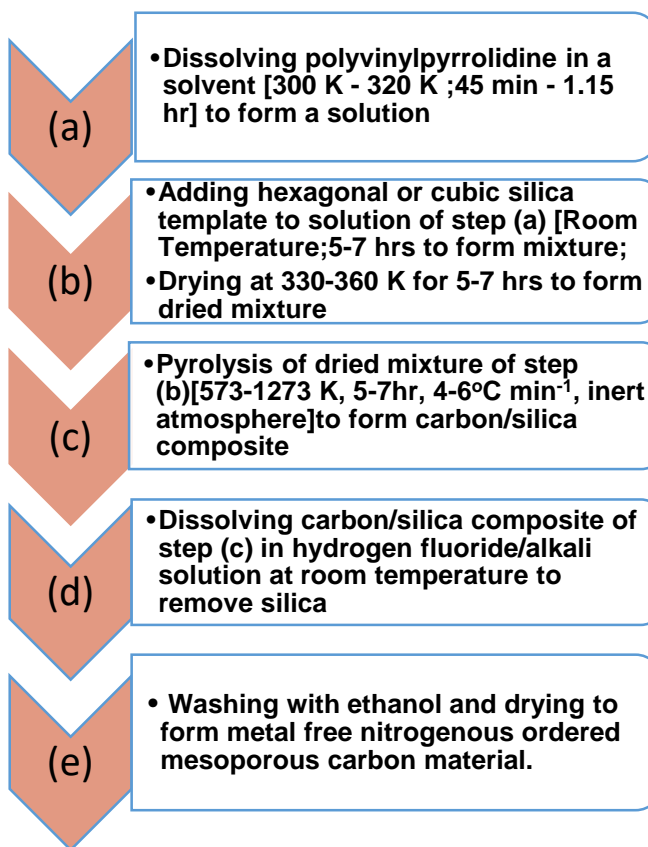
**User Perspective:**

- ❑ High efficiency, eco-friendly by product, cost-effective stationary and portable applications and flexibility of usage in transportation
- ❑ These catalysts can be effectively used in fuel cells as cathodes for ORR to avoid cross over effects

**Technology**

- The present invention discloses a process for preparing nitrogenous ordered mesoporous carbons using hexagonal or cubic silica templates and nitrogen-containing organics
- Further discloses metal free nitrogenous ordered mesoporous carbon material using the hard template method taking polyvinyl pyrrolidone as a precursor thereby avoiding metal chlorides as polymerizing agents and studied their ORR abilities in alkaline medium for fuel cell
- Said nitrogenous ordered mesoporous carbon as catalyst for oxygen reduction reaction in alkaline fuel cells

**METHOD:**



**CONTACT US**

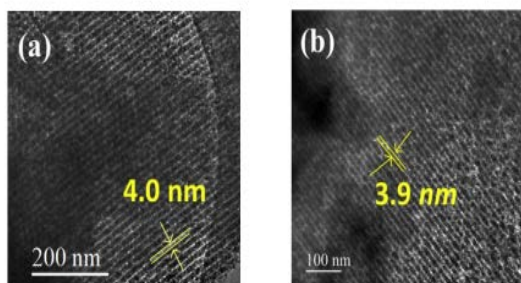
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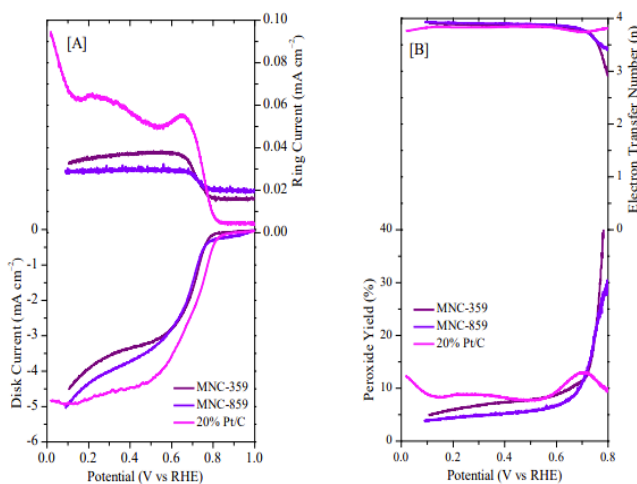
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**Image**

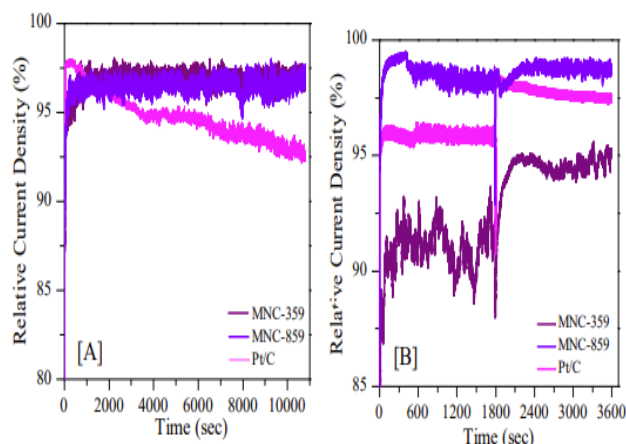


**Figure 1** illustrate TEM images of: **(a) MNC-359** and **(b) MNC-859**

- The hexagonal or cubic silica templates are selected from **SBA-15** and **KIT-6**
- The template free carbon product, wherein **synthesised** ordered mesoporous nitrogen containing carbon were denoted as **(a) MNC-359** and **MNC-859** respectively



**Figure 2** illustrate [A] Hydrodynamic linear sweep voltammograms in oxygen saturated 0.1 N KOH electrolyte at a rotation speed of 1600 rpm with a scan rate of 20 mV/s and [B] **Peroxide yields and electron transfer numbers** calculated from the RRDE measurement results of prepared 25 metal-free N-doped ordered mesoporous carbons



**Figure 3** illustrate [A] Chronoamperometric **stability responses** of N-doped ordered mesoporous carbons at 0.7 V from the oxygen saturated 0.1 N KOH for the catalysts. [B] **Methanol tolerance responses** of N-doped ordered mesoporous carbons compared to commercial Pt/C catalyst at 0.7 30 V from the oxygen saturated 0.1 N KOH for the catalysts

**TRL (Technology Readiness Level)**

**TRL- 4 Technology validated in lab**

**Research Lab**

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