



Industrial Consultancy & Sponsored Research (IC&SR)

A CHROMIUM OXYNITRIDE ELECTROCHEMICAL STORAGE DEVICE AND A CHROMIUM OXYNITRIDE NANOPARTICLE ELECTRODE

IITM Technology Available for Licensing

PROBLEM STATEMENT

- ❑ Researchers are studying metallic nitrides, specifically **chromium nitride and chromium oxynitride**, due to their electrical, optical, mechanical, and tribological properties.
- ❑ These materials are used in **anti-wear and corrosion films** due to their high hardness and resistance.
- ❑ Chromium nitride is also used in electrochemical energy storage, particularly as a **super capacitor**.
- ❑ Super capacitors have high capacitance, making them **faster to store electricity** than batteries.
- ❑ They store charge through two main mechanisms: electrical double layer (EDL) capacitance and pseudo capacitance.
- ❑ **Nano-structuring strategies are being explored** to enhance electrochemical energy storage and **catalytic applications**.

TECHNOLOGY CATEGORY MARKET

Technology: A Chromium Oxynitride Nanoparticle electrode used in supercapacitor.

Category: Micro & Nano Technologies/ Chemistry & Chemical Analysis/ Electronics & Circuits.

Industry: Metallurgical/Chemical /Energy.

Application: Advanced Materials, Clean Energy

Market: The global market size of nanoparticles is estimated to grow from **USD 5.1 billion in 2023 to USD 15.1 billion by 2035**, representing a **CAGR of 9.4%** during the forecast period **2023-2035**.

INTELLECTUAL PROPERTY

IITM IDF Ref. 1948
Patent No: IN 534594

TRL (Technology Readiness Level)

TRL-4, Experimentally validated in Lab;

Research Lab

Prof. Tiju Thomas,
Dept. of Metallurgical and Materials Engineering, IIT Madras.

TECHNOLOGY

- A **Chromium Oxynitride** electrochemical storage device/ Chromium Oxynitride nanoparticle electrode consists of a
 - **Positive Electrode**,
 - **Negative Electrode**, and
 - **Separator**, coated with chromium oxynitride nanoparticles on a charge substrate **acting as a current collector**.
 - Separator comprises an **anion**

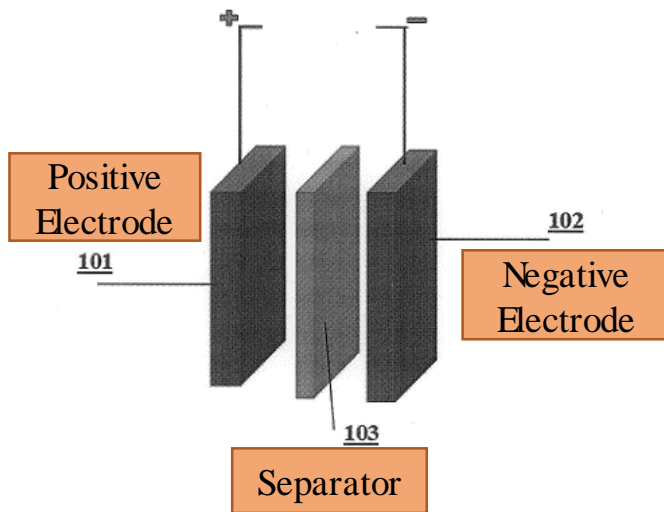


Figure 1 shows the illustration of a **supercapacitor** fabricated using CrON nanoparticle electrodes.

- The **charge substrate** is one of, selected from **nickel foam, carbon paper, carbon cloth, stainless steel, glassy carbon, titanium foil and copper foil**.

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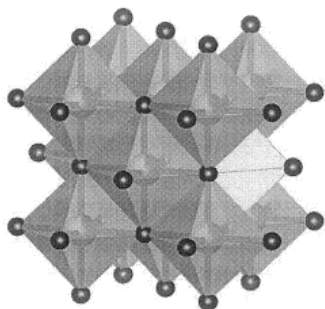


Fig 2 shows a **Crystal structure** of CrON nanoparticles

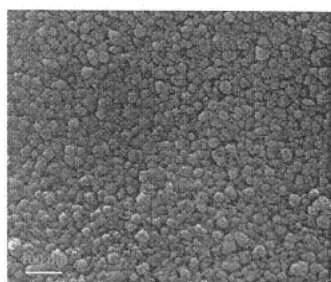


Fig 3 shows a **Nanospherical morphology** of CrON nanoparticles

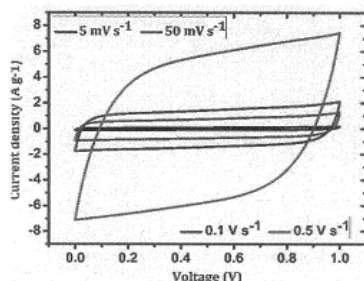


Fig 4 shows a **Cyclic Voltammetry**

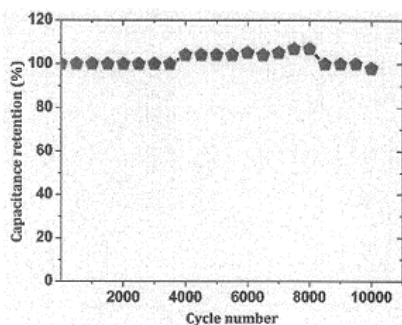


Fig 5 shows a depiction of the **cyclic stability and capacitance retention** of a coin cell supercapacitor

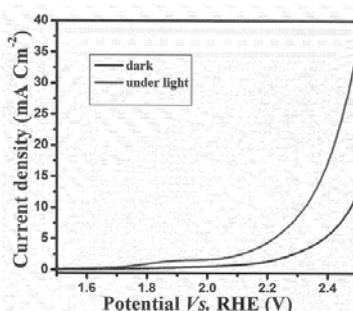


Fig 6 shows a **photocurrent measurement** of CrON nanoparticles under **dark and light illumination** conditions for 3h,

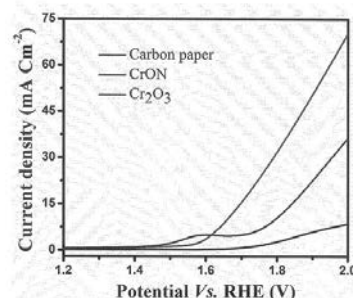


Fig 7 shows a The **electrocatalytic response** of CrON nanoparticles coated over carbon paper

Key Features / Value Proposition

- Device is used as a **super capacitor** with
 - **High cyclic stability**
 - 10000-15000 cycles
 - Excellent **capacitance retention (95-99%.)**
- **supercapacitor is fabricated structure**
 - **coin cell supercapacitor of 17-20mm diameter.**
- Maintains **92-98%** of specific capacitance even at **high current densities** exceeding **2 A g⁻¹.**
- Excellent **charge storage capability.**
- It has a **specific capacitance** ranging from
 - **140-150 Fg⁻¹** at a scan rate **5 mV s⁻¹** and
 - **80-90 F g⁻¹** at a scan rate **500 mV s⁻¹.**
- Generating a **photocurrent** of **30-40 mA cm⁻¹** in **1M KOH medium** Under light illumination of **300W Xenon lamp** for a period of 3h.
- Generating a current of **65-75 mA cm⁻²** at **5 mV s⁻¹** when dispersed in a suitable medium.

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