Indian Scientists Develop New Material for Supercapacitors

***Prelims**: Current events of national and international importance*

Why in news?

Recently, in joint research by the Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru, and Aligarh Muslim University (AMU), have developed an advanced material that significantly improves supercapacitor performance.

- **Supercapacitor** – It is also known as ultra-capacitor, is a capacitor having a capacitance **value much greater** than that of an ordinary capacitor.
- **Working principle** – Same as ordinary capacitors which store energy by separation electrical charges.
- But Supercapacitors use electrodes with larger surface area and ion-permeable membrane (separator) instead of traditional dielectric.
- Generally, a supercapacitor has electrodes that are coated with active carbon as electrode material.
- The supercapacitor uses a separator between its electrodes instead of a dielectric material (Used in normal capacitor).
- The separator is an **ion permeable membrane** that can provide both insulation and exchange of ions from electrolyte between the electrodes.
- Supercapacitors are known for rapid charge/discharge cycles.
- **Limitation** – Limited energy storage capacity compared to batteries due to lower energy density.
- **Lanthanum-doped silver niobate ($AgNbO_3$)** – Lanthanum-doped Silver Niobate ($AgNbO_3$) is used as an advanced electrode material for supercapacitors by Indian researchers.
- **Role of lanthanum doping** – By introducing lanthanum (rare-earth element) into silver niobate nanoparticles, scientists improved electrical conductivity and reduced particle size.
- **Higher energy density –** The reduced particle size which increases the surface area available for charge storage and improves the energy density, which means the supercapacitor can store more energy per unit volume or weight.
- It also achieved 118% energy retention even after repeated use and,
- 100% coulombic efficiency, meaning no energy loss during charging or

discharging cycles.

- **Successful real-world demonstration** – A prototype asymmetric supercapacitor made with the material was able to power an LCD display, demonstrating its practical potential for consumer electronics and energy systems.

Reference

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