

Multifunctional films with low-emittance and photocatalytic properties to energy-efficient-windows

Our group is developing multifunctional $\text{TiO}_2/\text{SnO}_2:\text{F}$ stacked-films with both photocatalytic and low-emittance properties. The thin-films of TiO_2 are formed on $\text{SnO}_2:\text{F}$ -coated glass substrates by reactive magnetron sputtering under various deposition conditions. Control of the electronic structure in the near-surface region is the key to obtaining excellent photocatalytic performance, which is confirmed by low-energy electron energy loss spectroscopy in the core electron excitation regions. The application of these films to energy-efficient-windows allows the possibility for reducing the energy load of the heating system and making the living space comfortable.

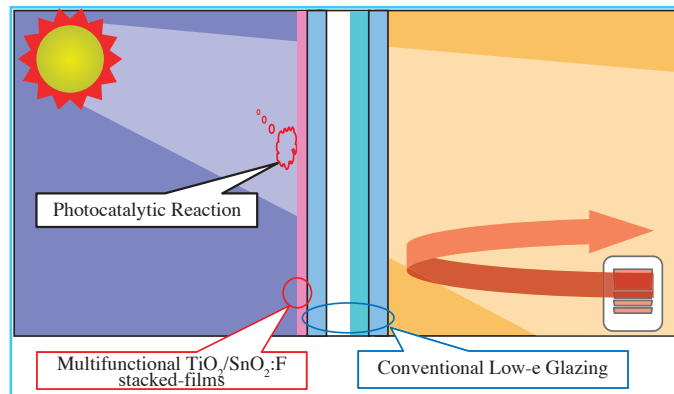


Figure: Novel energy-efficient-window with both low-emittance and photocatalytic properties.

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Nanoporous Materials for Lithium Storage Device with High Power and High Energy Densities

A newly developed crystalline-glass mesoporous nanocomposite (CGMN) $\text{TiO}_2\text{-P}_2\text{O}_5$ has been applied to a negative electrode of lithium rechargeable battery. The transport of lithium ions (Li^+) and electrolyte solution is facilitated by oriented nano-channel structures. The chemical adsorption/desorption of lithium ion at enormous surface area of the nano-channels realizes super-capacitor function to ensure high energy density as comparable to conventional lithium rechargeable batteries and to upgrade the power density by two orders of magnitude or more. Furthermore, providing electronic conduction property to the framework by incorporating electronic conductive oxides into the framework of $\text{TiO}_2\text{-P}_2\text{O}_5$ CGMN significantly improves charge-discharge characteristics.

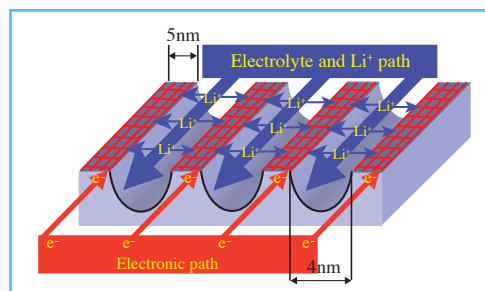


Fig 1: The image of CGMN with both electronic path and Li^+ path for high energy and high power densities.

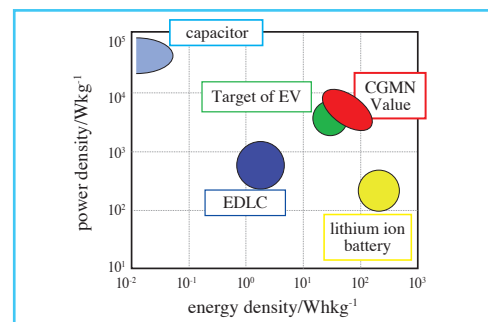


Fig 2: A Ragone plot showing the positions of CGMN, lithium battery, EV target, EDLC and capacitor for energy and power densities.

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