

Vanadium Oxide-based electrochromic devices for display applications

By

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M.Tech. Scholar



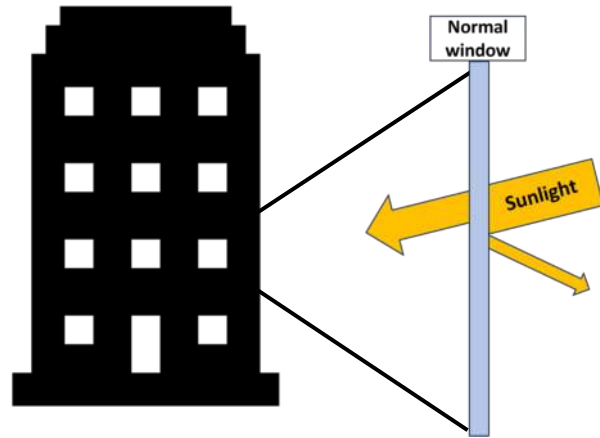
Guide

Prof. Parasuraman Swaminathan

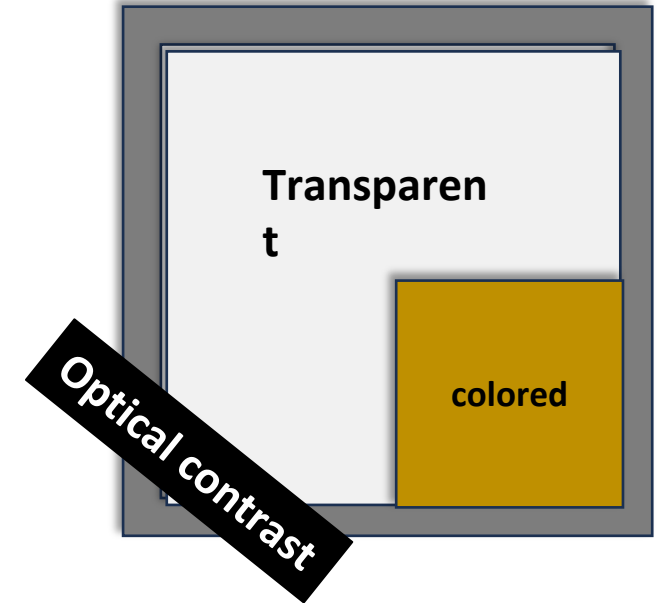
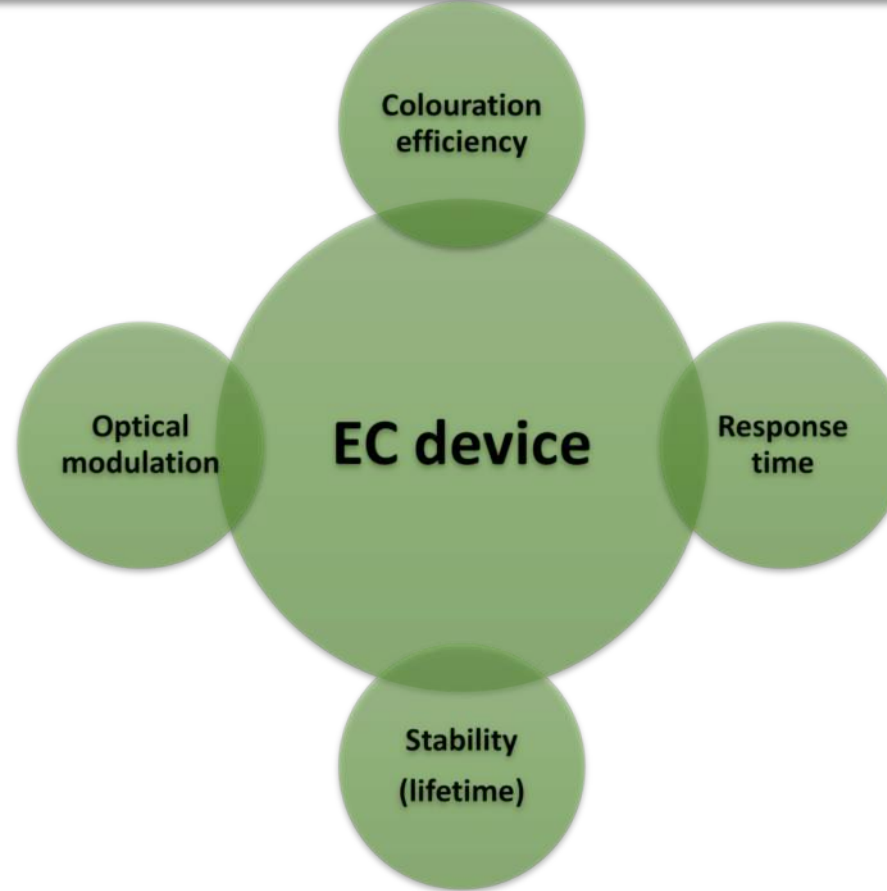
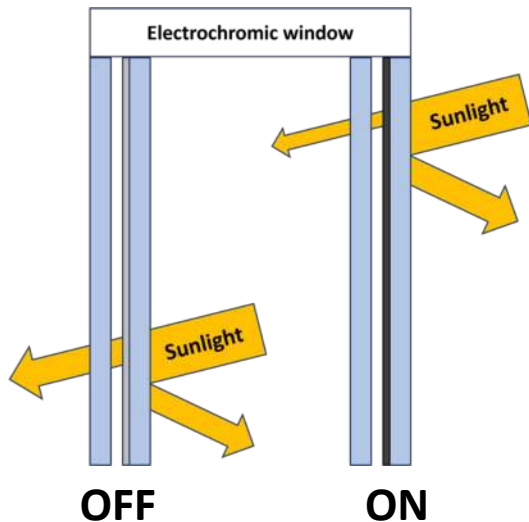
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Problem statement

AC – 30% of total energy used

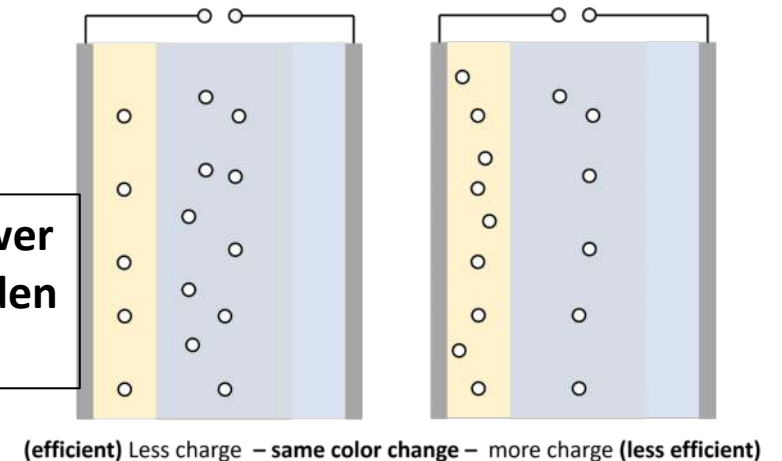


Transmittance is lower



Limited colors

Efficiency is lower
But have a hidden
advantage



Selection of Electrochromic material

- Various oxidation states +5 +4 +3 +2
- Whether the phases shows electrochromism ? – yes
- Layered structure – more advantageous
- Multiple colour – grey, green, yellow
- Stable oxides
- Good structural integrity - adhesion

Vanadium pentoxide - V_2O_5

Challenges in Lithium

- Hazardous
- Require glove box
- Increasing price
- Environmental impact
- Recycling issues



Alkali metals – a suitable alternative

Structural optimization

- Nanowires, nanosheets, nanorods – which is better?
- Thin films – increases transmittance
- Larger surface area
- Pores for ion intercalation
- Is it feasible to obtain this structures using other methods?
– yes, annealing plays a crucial role

Thin Nanosheet films

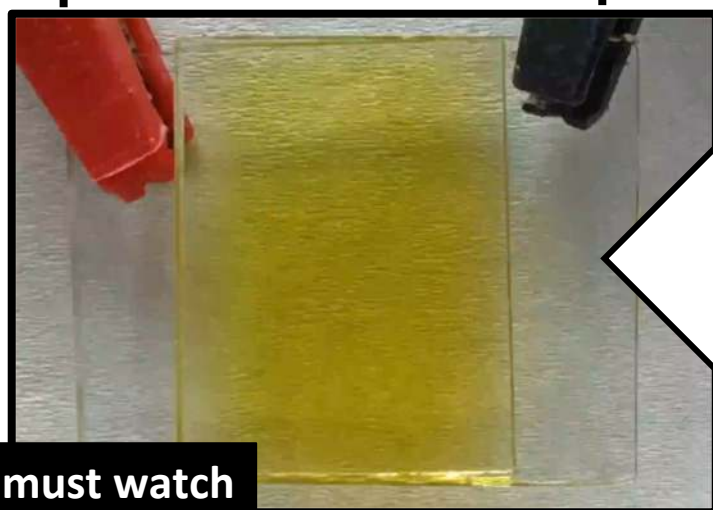
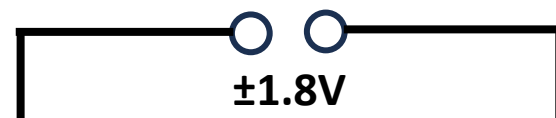
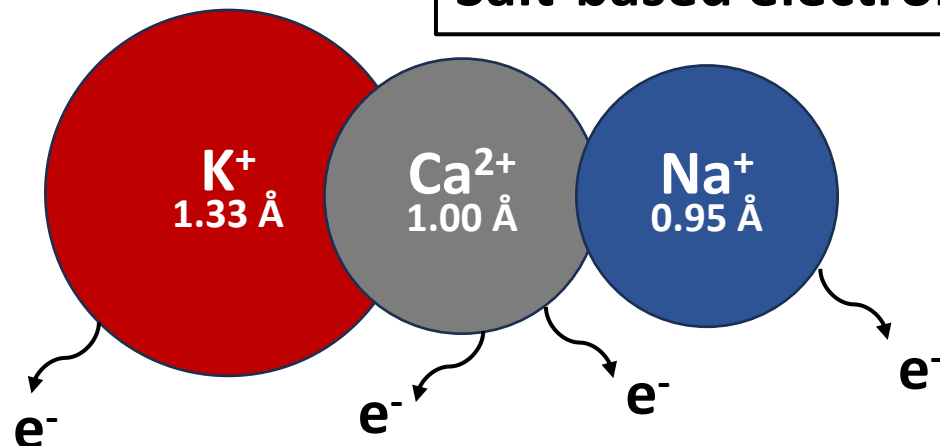
Selection of electrolytes

- Optimum ionic sizes – compatibility with structures
- Easily ionized
- Number of electron transfer – high is good
- High theoretical capacity
- Last but not least – ecofriendly

$NaCl$, KCl , $CaCl_2$

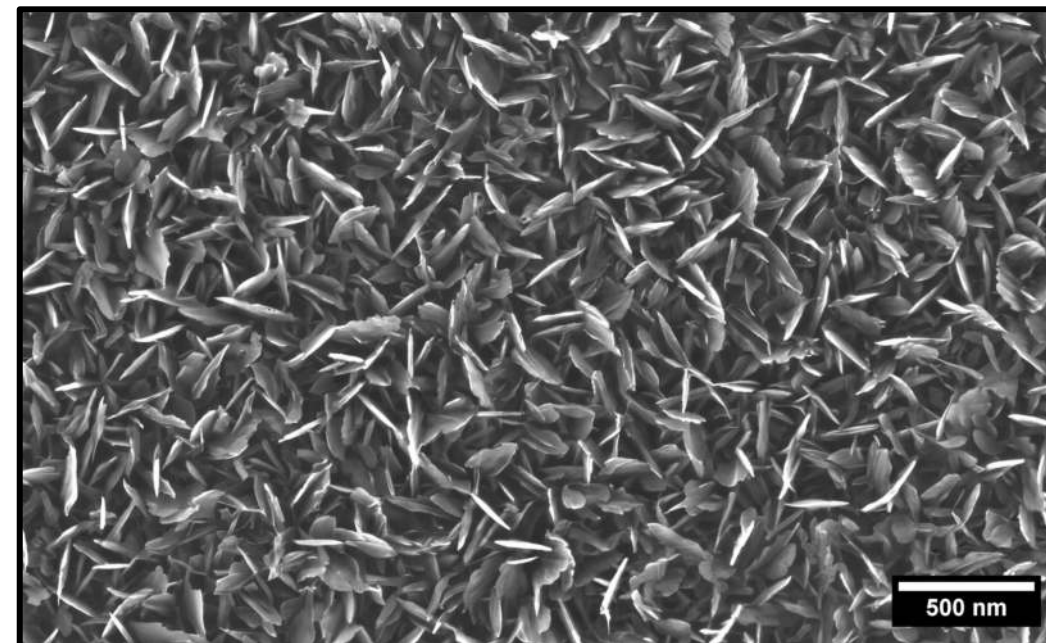
Novelty

Salt-based electrolytes



FTO counter
electrode

Video – must watch



Macroporous nanosheet

- More active surface area
- More electron transfer per site
- No deposition for counter electrode
- Eco-friendly electrolyte