ABSTRACT BOOK

INESS

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Using solar energy by a smart window for the needs of urban residents

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Development of a smart device containing solar panels, carrying out both energy and dust collection, decorative and productive gardening, regulation of light, heat and sound flow into the room is described. The aim of this development is to increase consumer attractiveness for individuals and profitability of the device using solar panels in urban conditions. Relevance of the study is also related to global sustainable development goals [1], namely: Goal 11 - aimed at improving the ecology of cities, Goal 7 - promoting the use of clean energy and Goal 13 - measures to combat climate change.

The device has a modular design principle to simplify installation and operation. The device consists of a main bearing module on which one can place 1-4 movable solar panels with a nominal power 125 W, a protective and dust-collecting dielectric plate, a block with vegetation, a washing and sprinkler unit and an automation unit that are connected to the overall electrical and mechanical circuit of the device powered by solar panels and the battery.

One of the features of the developing device is simple use and mounting on the building window, presence of a movable plate that protects the front surface of the solar panel from contamination and picks up dust. The solar panel with the plate obscures the light and noise flow into the room, creates a heated and illuminated greenhouse for plants on the windowsill, thereby prolonging the photosynthetic activity of plants for the winter period and increasing the amount of absorbed greenhouse gases. The device control system, essentially a smart-window, runs on the basis of Arduino (C++) using arbitrary logic (scripts) for various events in and out of the room.

Currently, a working model reduced at a scale of 1:5 of the developing device has been manufactured, and a full-size model of the device has been made on the window of the Faculty of Physics and Technology.

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References:

Nanoporous pucked V₃O₅γ’-polymorph as cathode material for Li-ion batteries with enhanced electrochemical properties

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The layered α-V₂O₅ compound with Van der Waals interlayer spacing is considered as a model for Li insertion reactions and has been extensively investigated as cathode material for Li batteries in various voltage ranges [1]. We gave recent evidence for the interest of the pucked layer γ’-V₂O₅, polymorph allowing reversible Li insertion at a higher potential (+0.2 V) compared to α-V₂O₅ [2]. In the present work, we have investigated the electrochemical behaviour of γ’-V₂O₅ in the high voltage window (4 V-2.5 V) corresponding to the exchange of 1 Li/mole of oxide (147 mAh g⁻¹). Cycling properties, rate capability and kinetic parameters for Li insertion in γ’-V₂O₅ are reported here for the first time in the 4.0 V-2.5 V potential range. Nanoporous oxide particles were prepared from a solution technique leading to a very fine powder with porous morphology (figure a). A stable capacity of 140 mAhg⁻¹ over 50 cycles at C/2 is obtained (figure b) while a remarkable value of 110 mAhg⁻¹ is still achieved at 10 C. All the data are discussed at the light of the structural mechanism recently evidenced for γ’-V₂O₅. A promoting nanosize effect is demonstrated on the electrochemical performance of γ’-V₂O₅.

(a) SEM image and (b) cycling properties (C/5 rate) of γ’-V₂O₅

Reference: