Supporting Information

Adhesive Antibacterial Moisturizing Nanostructured Skin Patch for Sustainable Development of Atopic Dermatitis Treatment in Humans

*Alicja Kosik-Kozioł[a], Paweł Nakielski[a], Daniel Rybak[a], Wiktoria Fraczek[b], Chiara Rinoldi[a], Massimiliano Lanzi[c], Marta Grodzik[b], Filippo Pierini[a]**

a. Department of Biosystems and Soft Matter, Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw, 02-106, Poland
b. Department of Nanobiotechnology, Institute of Biology, Warsaw University of Life Sciences, Warsaw, 02-777, Poland
c. Department of Industrial Chemistry "Toso Montanari", Alma Mater Studiorum University of Bologna, Bologna, 40136, Italy

*Corresponding author: fpierini@ippt.pan.pl

Keywords: atopic dermatitis, core-shell electrospun nanofibers, antibacterial, mucoadhesive, moisturizing patch.

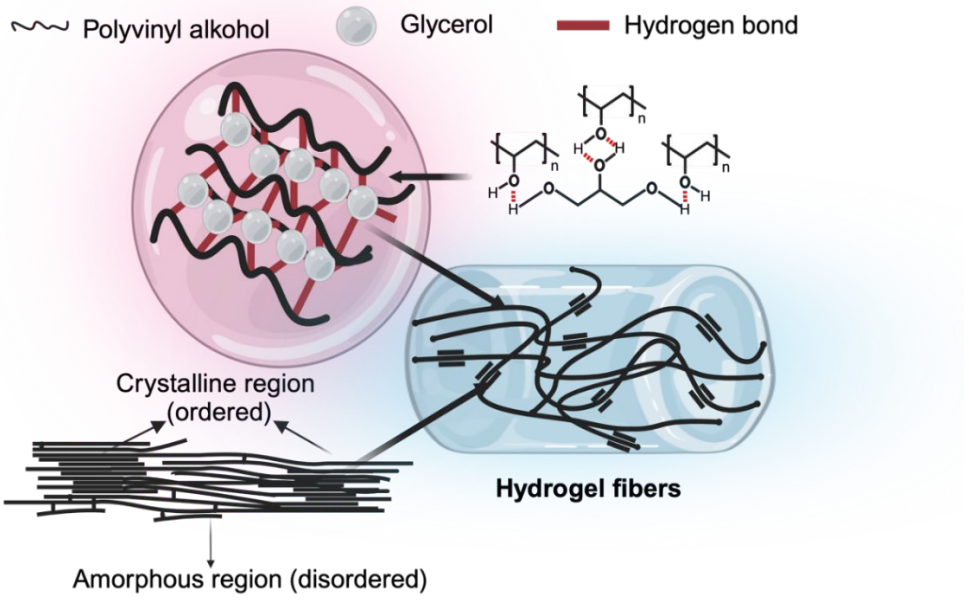

Figure S1. Schematic illustration of eco-friendly Gly crosslinking of PVA. *PVA, a water-soluble polymer rich in hydroxyl (-OH) groups, forms hydrogen bonds with water and other H-bonding molecules such as glycerol (containing three hydroxyl groups). When combined, PVA and glycerol create intermolecular crosslinks. Gly functions as a plasticizer, enhancing polymer chain mobility and facilitating the formation of crystalline regions, leading to improved mechanical strength, elasticity, and decreased solubility of PVA fibers.*

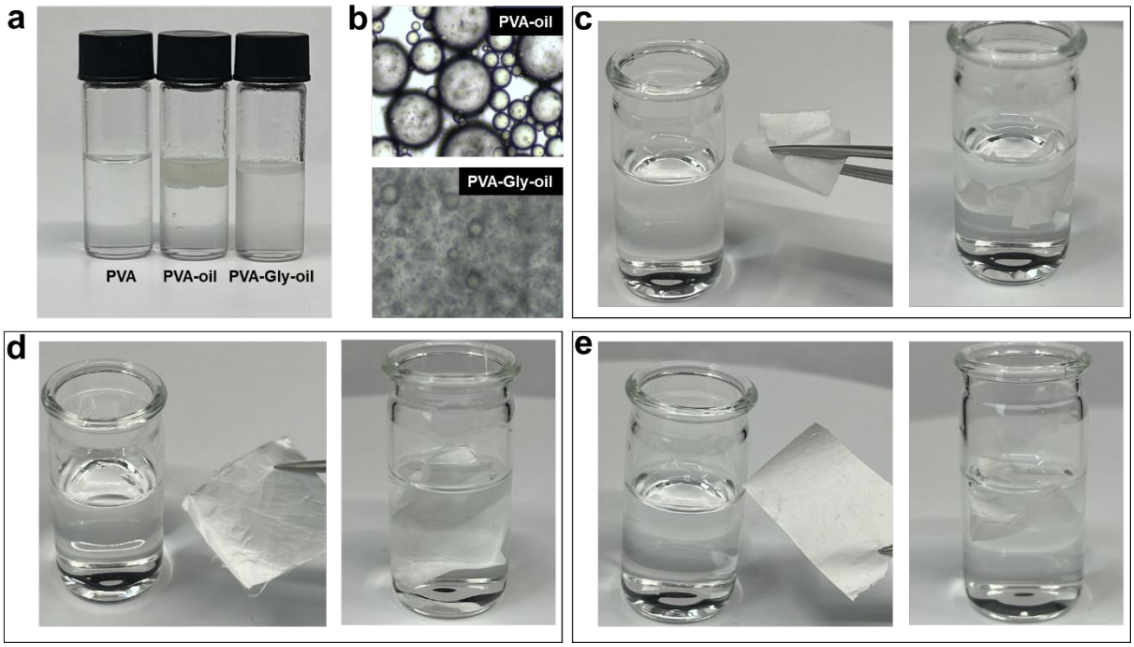

Figure S2. The Influence of Gly on Oil Solubility and Nanoplatform Behavior in an Aquatic Environment. ***(a)*** *Impact of Glycerin on Oil Solubility in PVA Solution: PVA, PVA + argan oil, PVA-Gly + argan oil.* ***(b)*** *Microscopic View of Oil Emulsion Formation for PVA + argan oil and PVA-Gly + argan oil Solutions.* ***(c-e)*** *Solubility Test for Electrospun mats presenting mats before and after immersion in diH_20.* ***(c)*** *PVA-Gly.* ***(d)*** *PAN.* ***(e)*** *CS*

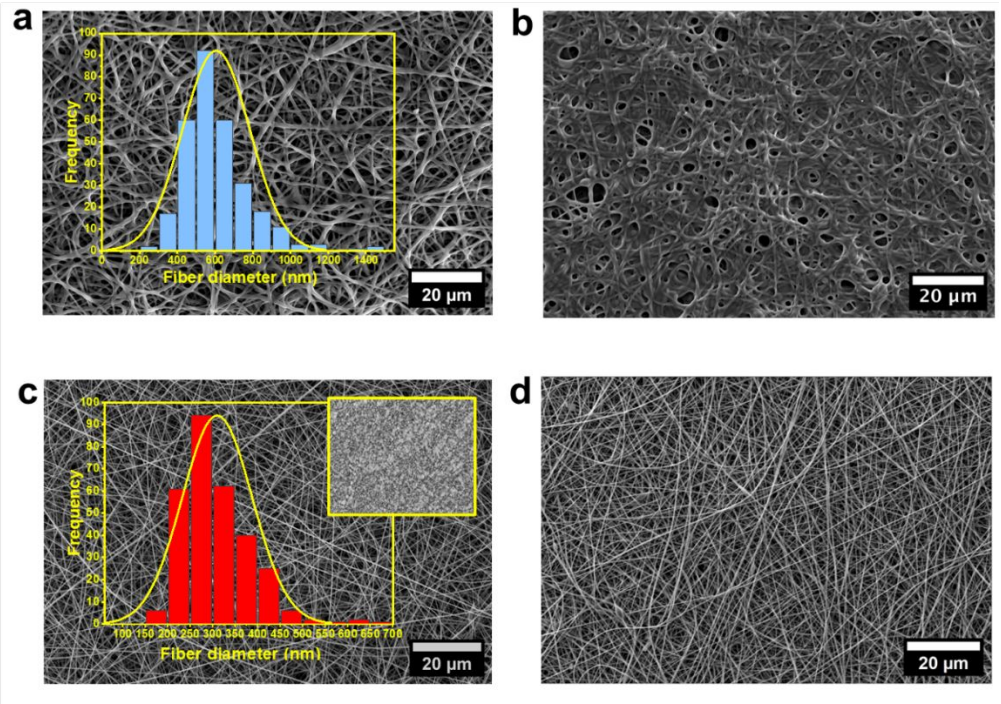

Figure S3. Solubility assessment of PVA-Gly and CS nanofibers in a water environment over 1 month by scanning electron microscopy images. ***(a)*** *PVA-Gly nanofibers with fiber diameter distribution.* ***(b)*** *PVA-Gly nanofibers after incubation in diH_2O for 1 month.* ***(c)*** *CS nanofibers with fiber diameter distribution and coherency map. Coherency indicates the extent to which structures are aligned, with a coherency value of 0 representing complete isotropy in an image and a value of 1 denoting highly aligned structures.* ***(d)*** *CS nanofibers after incubation in diH_2O for 1 month.*

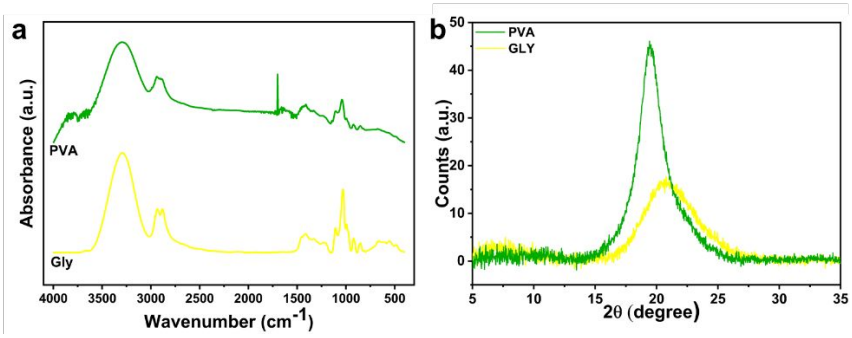

Figure S4. Physico-chemical characterization of PVA fibers without crosslinking and Gly solution. ***(a)*** *ATR-FTIR spectra.* ***(b)*** *XRD diffractograms.*

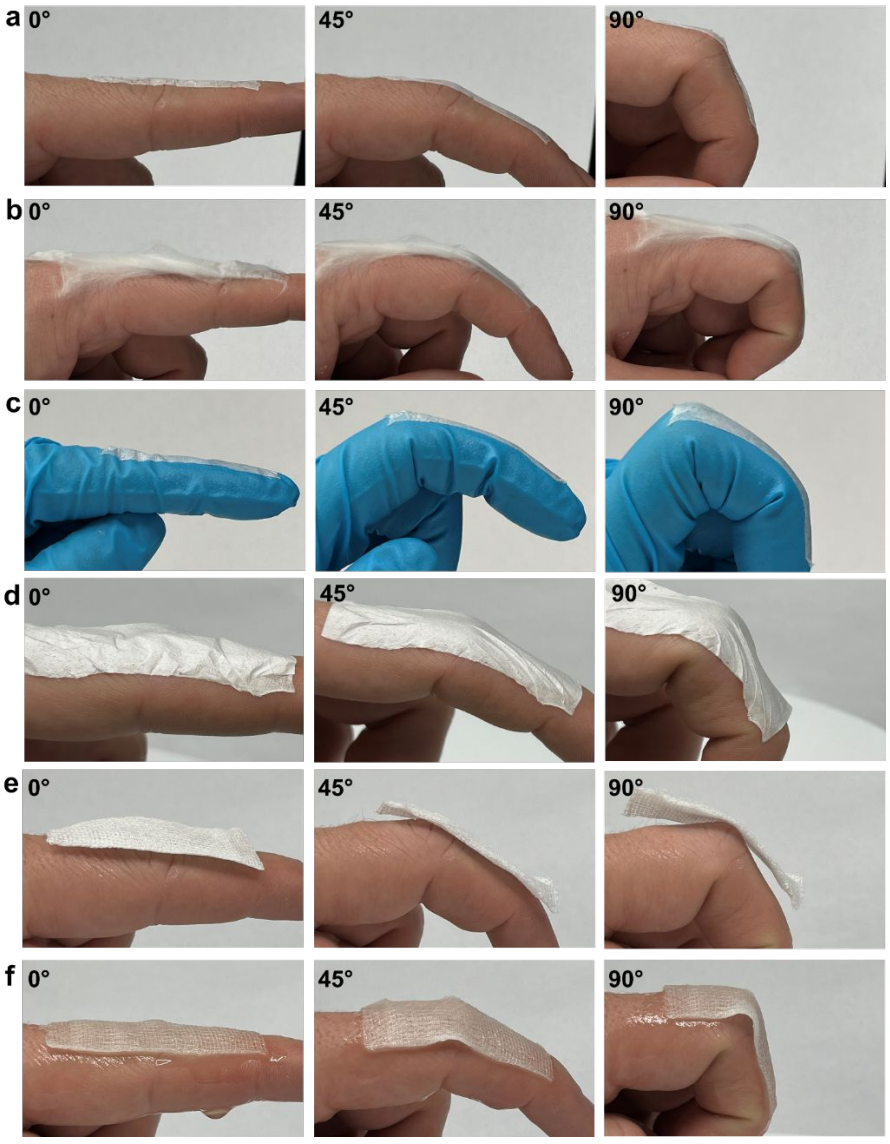

Figure S5. Application of the different patches on the finger illustrating the material's strong adhesion during bending at 0°, 45°, and 90° positions. ***(a)*** *PVA-Gly electrospun nanofibers.* ***(b)*** *PAN electrospun nanofibers.* ***(c)*** *CS electrospun nanofibers placed on the nitrile gloves.* ***(d)*** *CS-A electrospun nanofibers.* ***(e)*** *Commercial cotton-wool gauze.* ***(f)*** *Commercial cotton-wool gauze soaked with fermented argan oil.*

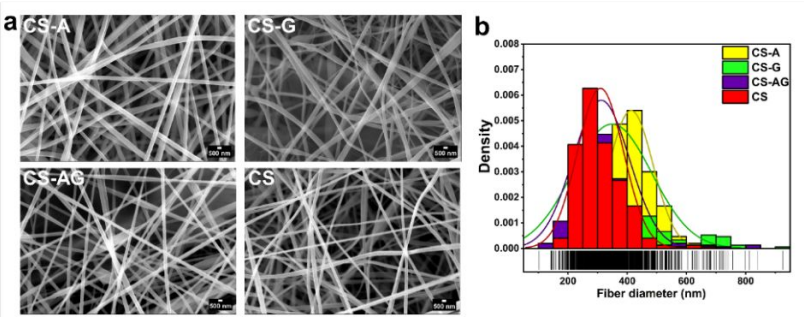

Figure S6. Characterization of CS nanofibers with ferment oils: argan oil (CS-A), green tea oil (CS-G), a combination of argan and green tea oils (CS-AG), and without oils (CS). ***(a)*** *SEM images of CS-A, CS-G, CS-AG, CS nanofibers.* ***(b)*** *Distributions of CS-A, CS-G, CS-AG, CS nanofibers diameters*

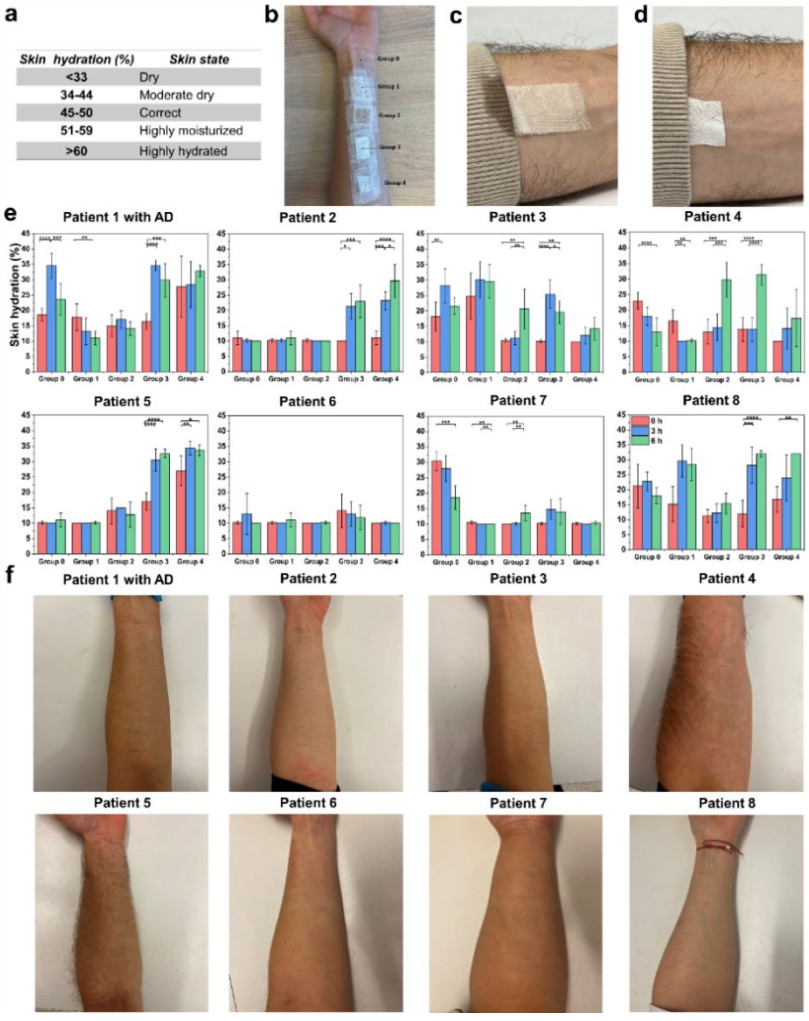

Figure S7. Skin patch application tests conducted on 8 patients' forearms. ***(a)*** *Skin condition analyzer manufacturer instructions depicted skin state according to measured skin hydration.* ***(b)*** *Photos of group positioning on the forearm: Group 0 - Skin Reference, Group 1 - Gauze, Group 2 - Gauze soaked with argan oil, Group 3 - CS, Group 4 - CS-A.* ***(c)*** *Oil-saturated gauze (Group 2) placed on the skin causes the cloth staining.* ***(d)*** *CS-A (Group 4) placed on the skin does not stain the cloth.* ***(e)*** *Photos of patients' forearms after removing the patches at the end of the experiment. Patient no. 1 suffers from atopic dermatitis (AD, eczema).* ***(f)*** *Photos displaying the forearm skin condition of 8 patients following skin patch application tests.*