Emerging investigator series: CeO_2/CuO Nanostructured Composite with Enhanced Antimicrobial Properties and Low Cytotoxicity to Human Keratinocytes *in vitro*.

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Supplementary materials.

1. X-ray Diffraction (XRD)

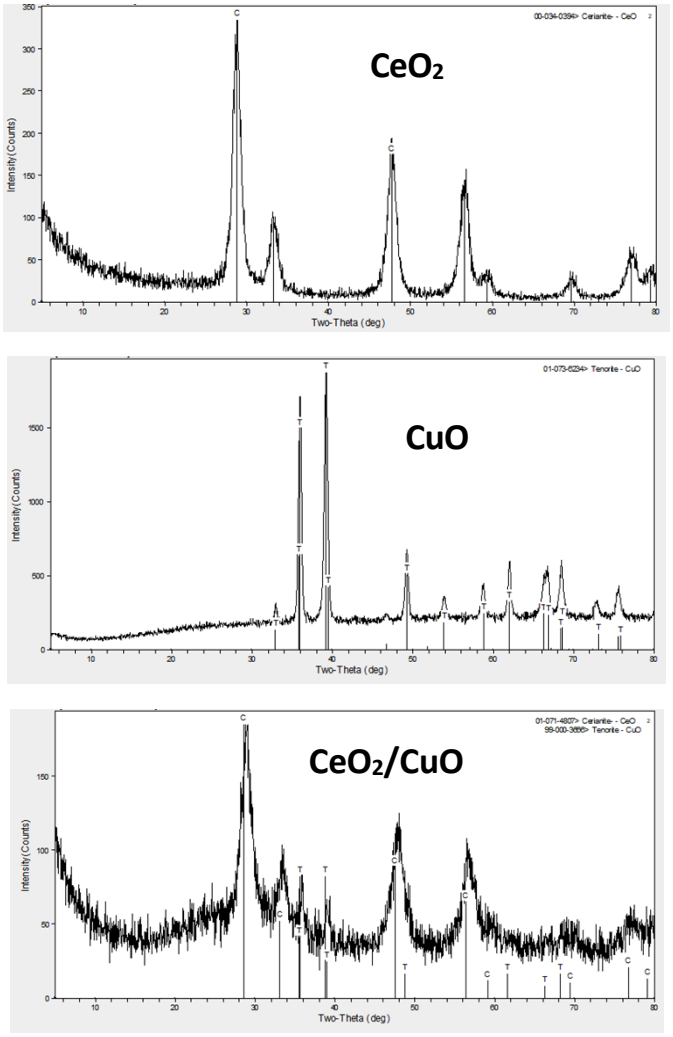

Figure S1. XRD patterns of CeO_2, CuO, CeO_2/CuO.

2. Field emission scanning electron microscopy (FESEM) and Energy dispersive spectroscopy (EDS).

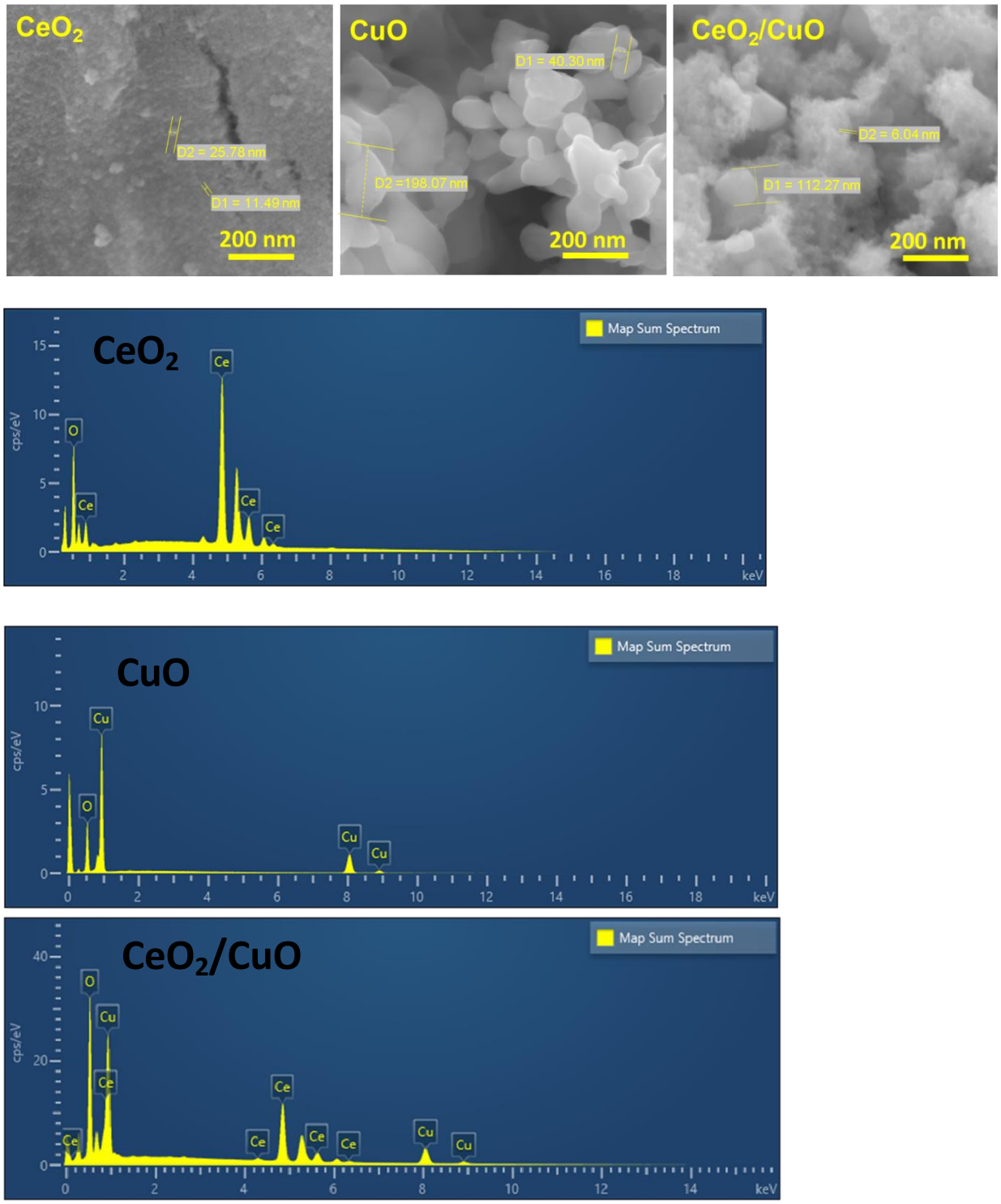

Figure S2. Example of the particle measurements (first row) and a representative energy dispersive spectroscopy (EDS) spectrum images of CeO_2, CuO, and CeO_2/CuO composite.

2. X-ray photoelectron spectroscopy (XPS)

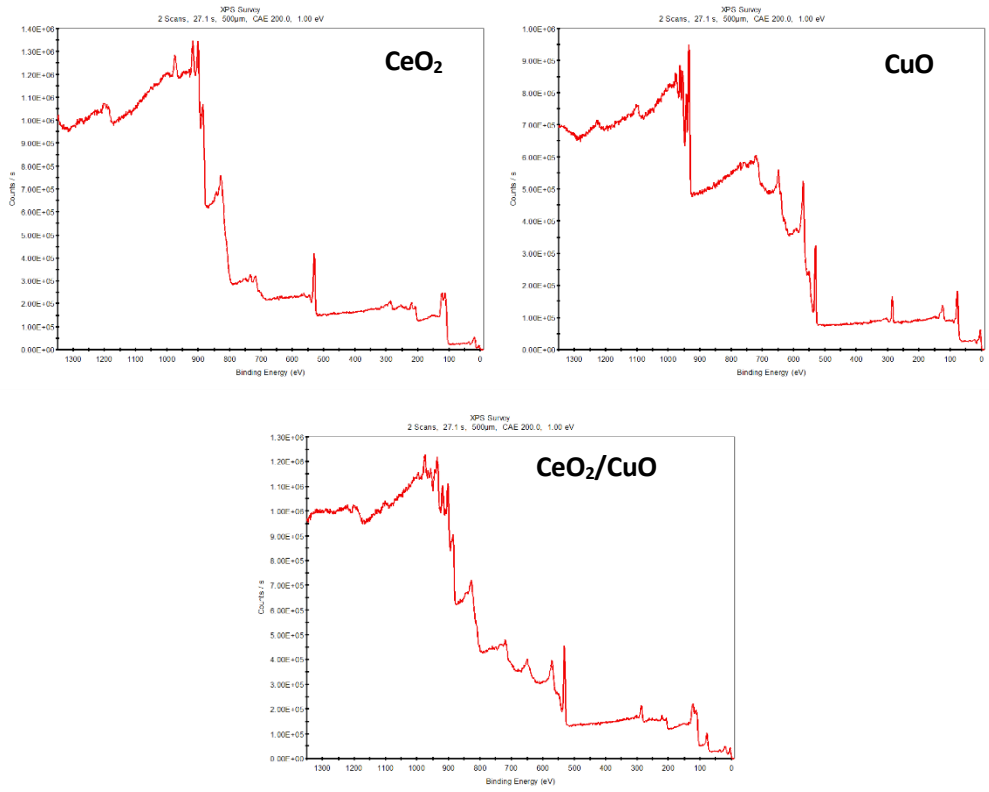

Figure S3. XPS surveys of CeO_2, CuO, and CeO_2/CuO/

3. Suspensions.

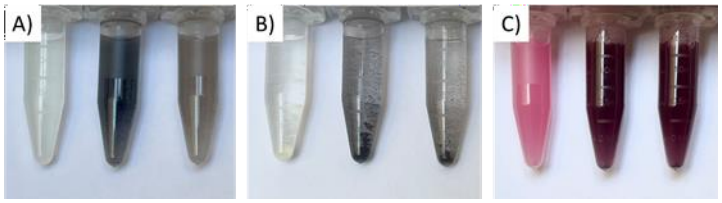

Figure S4. CeO_2, CuO, and CeO_2/CuO suspensions 1000 mg/L in: A) DI, B) 2%NaCl, C) DMEM.

4. Photos of the microbial colonies on agar plates (visualization of the results of the Spot test).

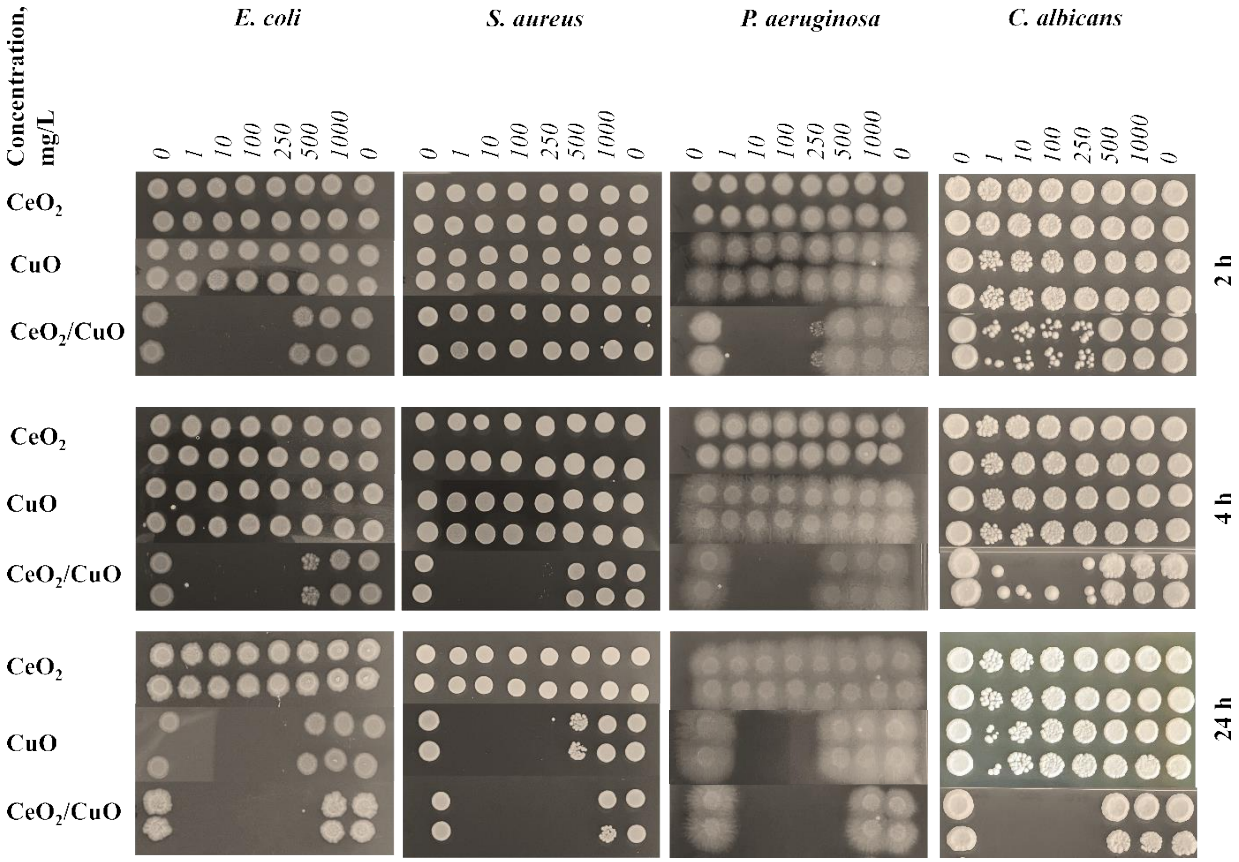

Figure S5. Viability (colony formation) of *Escherichia coli* (1st panels), *Staphylococcus aureus* (2nd panels), *Pseudomonas aeruginosa* (3rd panels) and *Candida albicans* (4th panels) after exposure to CeO_2, CuO and CeO_2/CuO in deionized water for 2 h (upper panels), 4 h (middle panels) and 24 h (lower panels) at room temperature. Viability was evaluated by the ability of exposed microorganisms to yield colonies at the nutrient agar plate as indicated on the panels.

5. Visualization of the Neutral Red Uptake (NRU) assay

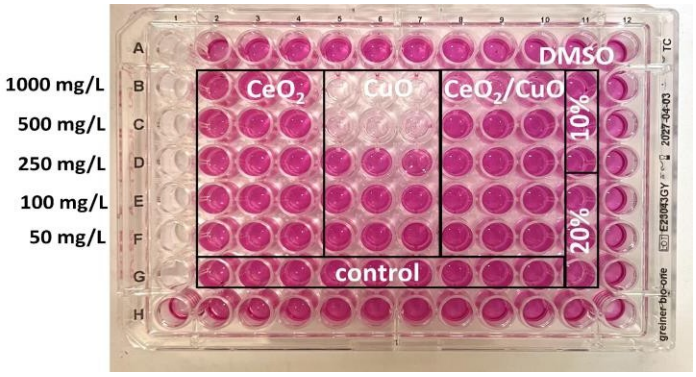

Figure S6. Visualization of the Neutral Red Uptake (NRU) assay with the HaCat cells after 2 h incubation.

6. Visualization of the Neutral Red Uptake (NRU) assay

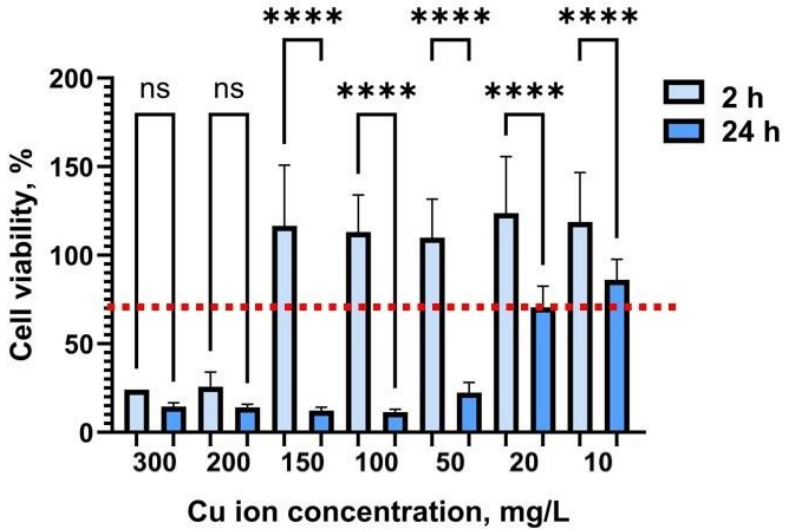

Figure S7. Viability of the Human keratinocytes cell line (HaCaT) after incubation with Cu ions. The asterisk (*) represents the p-value of the statistical test. No significant (NS) difference means that the p-value > 0.05. One asterisk indicates that the p-value ≤ 0.05. Two asterisks indicate that the p-value ≤ 0.01. Three asterisks mean the p-value is ≤ 0.001, and four asterisks mean the p-value is ≤ 0.0001.

CeO_2/CuO are effective against both Gram-negative and Gram-positive bacteria with a 24 h (MBC) of 10 mg/L (Table 2). In comparison, Cu ions show 10-times higher antibacterial potency, with a 24 h MBC of just 1 mg/L (Table 2). In terms of cytotoxicity to HaCaT cells CeO_2/CuO demonstrate low cytotoxicity, exhibiting cytotoxicity at 1000 mg/L after 24 h (Fig. 9 B). Cu ions, on the other hand, exhibit cytotoxicity at a much lower concentration of 50 mg/L after 24 h (Fig. S7). In summary, while Cu ions offer stronger antibacterial action, they also pose a greater risk of cytotoxicity.