Synthesis and photocatalytic activity of $H_2Ti_2O_5 .H_2O$/Ti electrodes decorated with CuO

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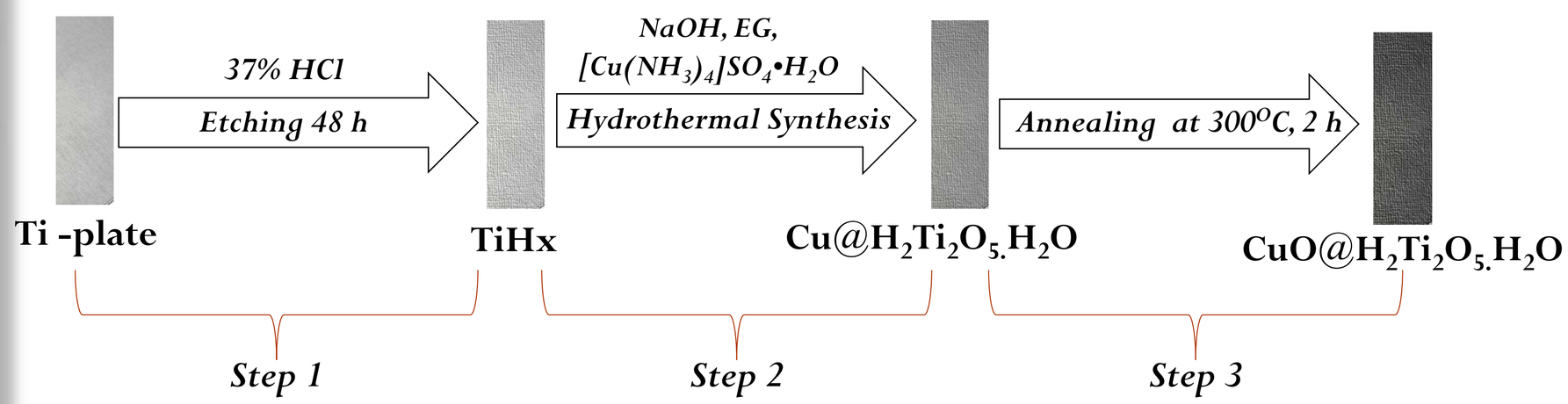
Introduction

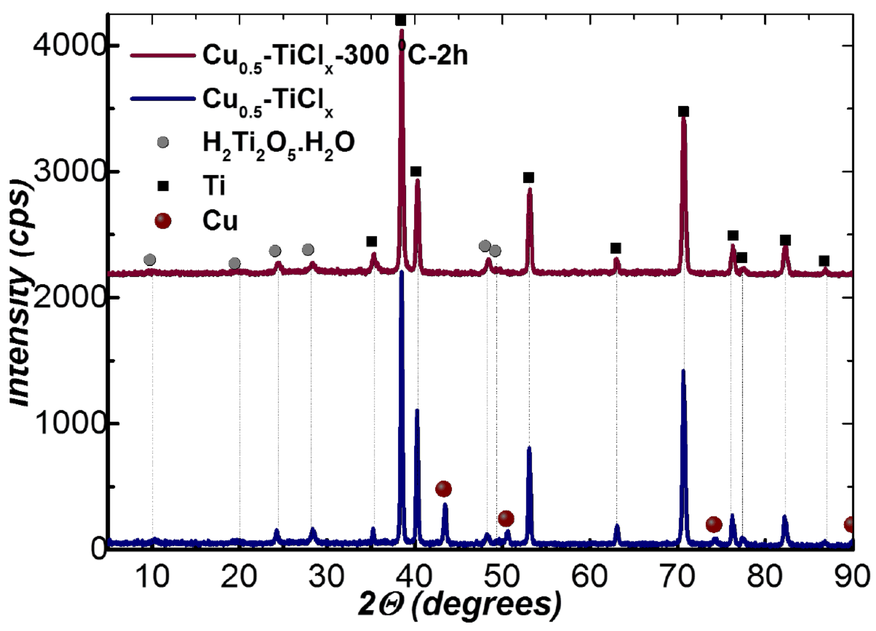
Layered titanates, a TiO_2 related material class, provide an appropriate band alignment for overall water splitting, ideal conditions for subsequent band gap modifications as well as an adequate photocatalytic activity for H_2 production. In this work, we have obtained titanic acid which proved to be $H_2Ti_2O_5 \cdot H_2O$ form by doping Cu^{2+} through hydrothermal method. The products showed potential to be a photocatalysts for water splitting according to the performed photocatalytic experiments.

Experimental

✓ **$CuO@H_2Ti_2O_5 .H_2O$/Ti electrodes were synthesized**



✓ **Physicochemical analysis was performed**

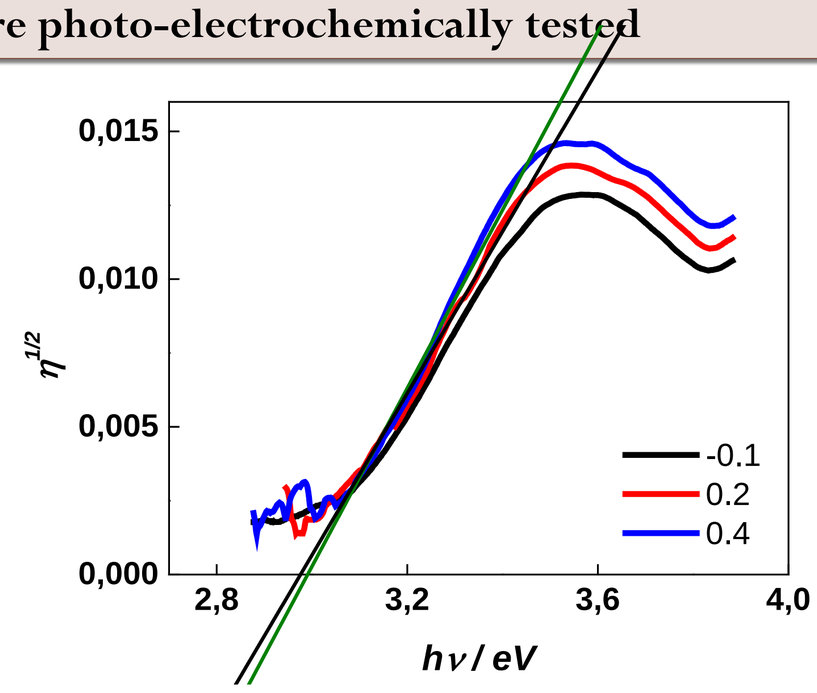


XRD patterns

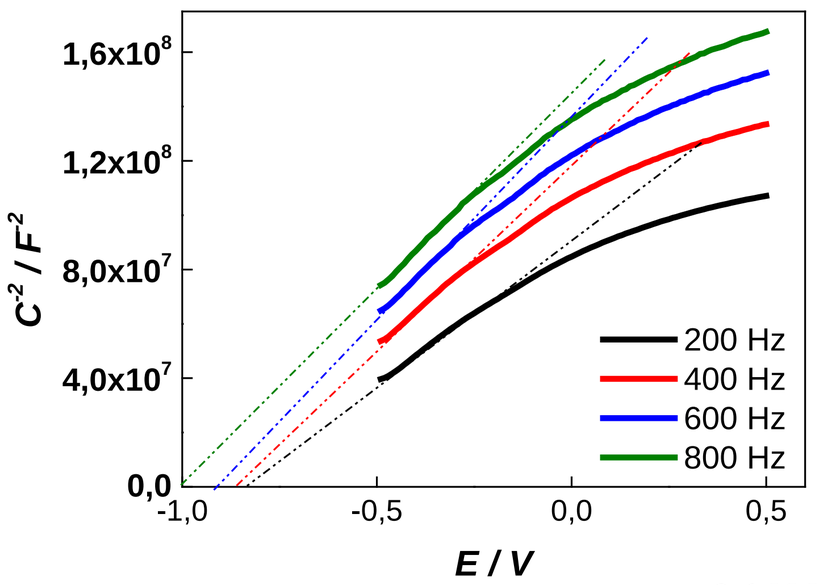
XRD data

Sample	Phases
$TiCl_x$	Ti, TiHx
$TiCl_x$ 300-2h	Ti
$Cu_{0.5}$-Ti	Ti, TiHx, Cu,
$Cu_{0.5}$-Ti 300-2h	Ti, $H_2Ti_2O_5H_2O$, CuO-Tenorite
$Cu_{0.25}$-$TiCl_x$	Ti, Cu, $H_2Ti_2O_5H_2O$,
$Cu_{0.25}$-$TiCl_x$ 300-2h	Ti, Cu, $H_2Ti_2O_5H_2O$
$Cu_{0.5}$-$TiCl_x$	Ti, Cu, $H_2Ti_2O_5H_2O$, Cu_2O
$Cu_{0.5}$-$TiCl_x$ 300-2h	Ti, $H_2Ti_2O_5H_2O$ and some CuO-Tenorite

✓ **The electrodes were photo-electrochemically tested**



*Tauc's plot of $Cu_{0.5}$-$TiCl_x$ 300-2h in **0.1 M KOH***



*Mott–Schottky plot of $Cu_{0.5}$-$TiCl_x$ 300-2h in **0.1 M KOH***

✓ Conclusions

✓ The X-ray diffractograms of the electrodes indicated that the treatment with HCl (Step 1) leads to formation of $H_2Ti_2O_5H_2O$ during the hydrothermal synthesis (HTS).

✓ The increase of concentration of the Cu precursor to 0.5 M facilitates the formation of Cu_2O during HTS. Oxides of Cu are not registered at low concentration (0.25 M)

✓ The band gap of the Cu0.5-TiClx-300-2h is estimated to be 3.0 eV.

✓ Mott-Schottky Analysis → both donor density and flat band potential frequency dependent → mean values of $(1.8\pm0.4)10^{20}$ cm^{-3} and -0.95±0.05 V vs. Ag/AgCl .

✓ Copper doping does not improve significantly the absorption of visible light by $H_2Ti_2O_5H_2O$/ TiO_2.

✓ Further optimization is in progress

✓ Acknowledgments

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