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Investigation of the Diffusion of Cr2O3 into different phases of TiO2 upon Annealing

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Chromium oxide (Cr2O3) can be used as a protective layer for photocatalysts to improve photocatalytic water splitting activity and is commonly photodeposited. However, it is not known how the conditions of the Cr2O3 formation affect the formation of the protective layer and potential diffusion into the substate onto which the Cr2O3 has been deposited. We have investigated the stability of Cr2O3 photodeposited onto the surface of different crystal phases of TiO2 with subsequent annealing at a range of temperatures up to 600^{0}C. X-ray photoelectron spectroscopy and synchrotron near-edge X-ray absorption fine structure were used to analyse the chemical composition of the sample, Neutral impact collision ion scattering spectroscopy was used to study the concentration depth profile of the elements in the sample and atomic force microscopy was used to investigate the morphology of the surface. Under annealing conditions, the Cr2O3 layer diffuses into the amorphous and anatase phases of TiO2 but remains at the surface of the rutile phase. This finding is attributed to differences in surface energy with Cr2O3 being higher in surface energy than the amorphous and anatase phases of TiO2 but lower in surface energy than the rutile phase of TiO2. Reduction of Cr2O3 to Cr metal was observed after annealing with no observation of the formation of higher oxidised forms of chromium oxide like CrO2 and CrO3. These findings are of general interest to researchers utilising a protective overlayer to augment photocatalytic water splitting.

Level of Expertise

Student

Presenter Gender

Man

Pronouns

He/Him

Which facility did you use for your research

Australian Synchrotron

Students Only - Are you interested in AINSE student funding

Yes

Do you wish to take part in the Student Poster Slam

No

Condition of submission

Yes

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