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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 substrate 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 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.

Presenter Gender

Man

Do you wish to take part in the Student Poster Slam

No

Condition of submission

Yes

Students Only - Are you interested in AINSE student funding

Yes

Level of Expertise

Student

Pronouns

He/Him

Which facility did you use for your research

Australian Synchrotron

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