Preparation and characterisation of alumina coated TiO_2: The influence of alumina coatings on physicochemical properties.

Steven L. Hall

Yefeng Li, Amin Farshchi, Andrew Bayly, David Harbottle, John Robb, John Edwards

1. Introduction

More than 7.5 million tonnes of TiO_2 are produced worldwide each year for use as white pigments in paints, plastics and paper (U.S. Geological Survey 2020).

TiO_2's use as a white pigment stems from its ability to scatter all forms of visible light and therefore appearing white to the human eye.

During manufacture, the TiO_2 is often coated with small amounts of hydrous alumina, which improves pigments stability, dispersibility, and processability, through reducing the van der Waals force.

$$F_{\mathrm{VDW}} = -\frac{aA_{\mathrm{H}}}{12H^2}$$

$$A_{H,\,TiO2} > A_{H,\,Al2O3}$$

Alumina films increase interparticle separation distance

Disadvantage: During the processing of plastics which is performed at high temperatures, the coatings can dehydrate releasing water, causing undesirable bubbles and poor mechanical properties (Day,, 1990).

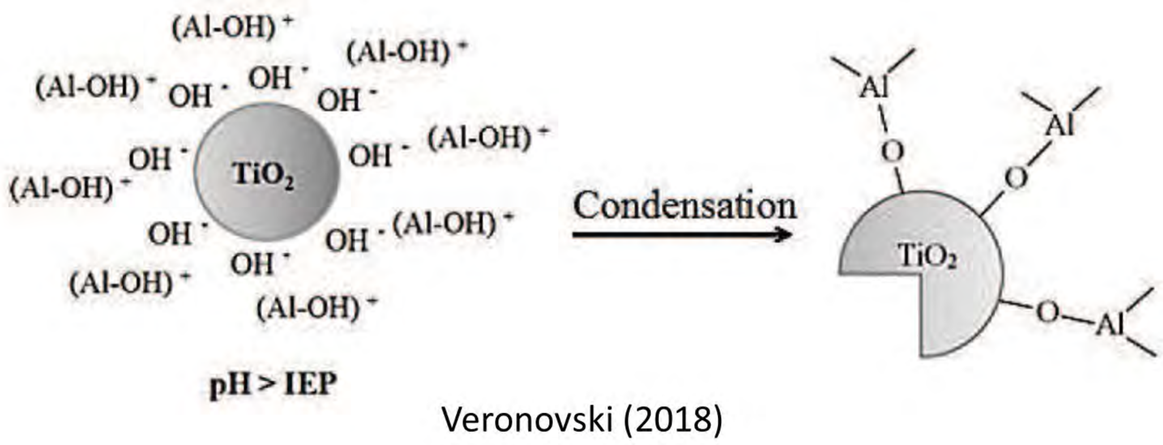
Therefore, a balance must be sought between processing the pigment in the first place and its use in the final application.

This contribution therefore investigates the influence of alumina coating levels (between 0 – 3 wt%) on the physicochemical properties of alumina coated titanium dioxide, providing new insights and quantitative data.

The findings of which can be used for the formulation and design of TiO_2 pigment products.

2. Preparation

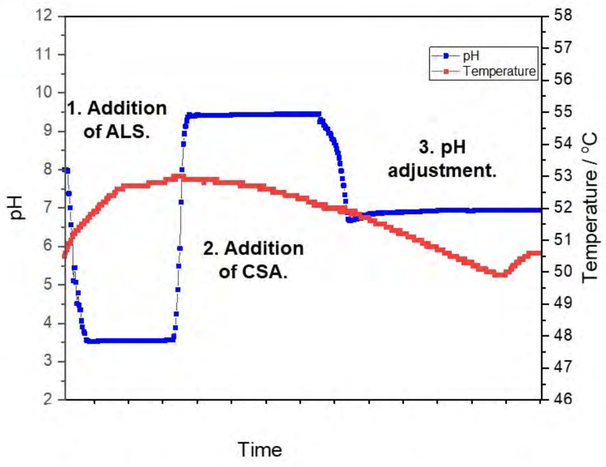
Alumina coating mechanism



Veronovski (2018)

Experimental procedure

Titanium dioxide coating rig.



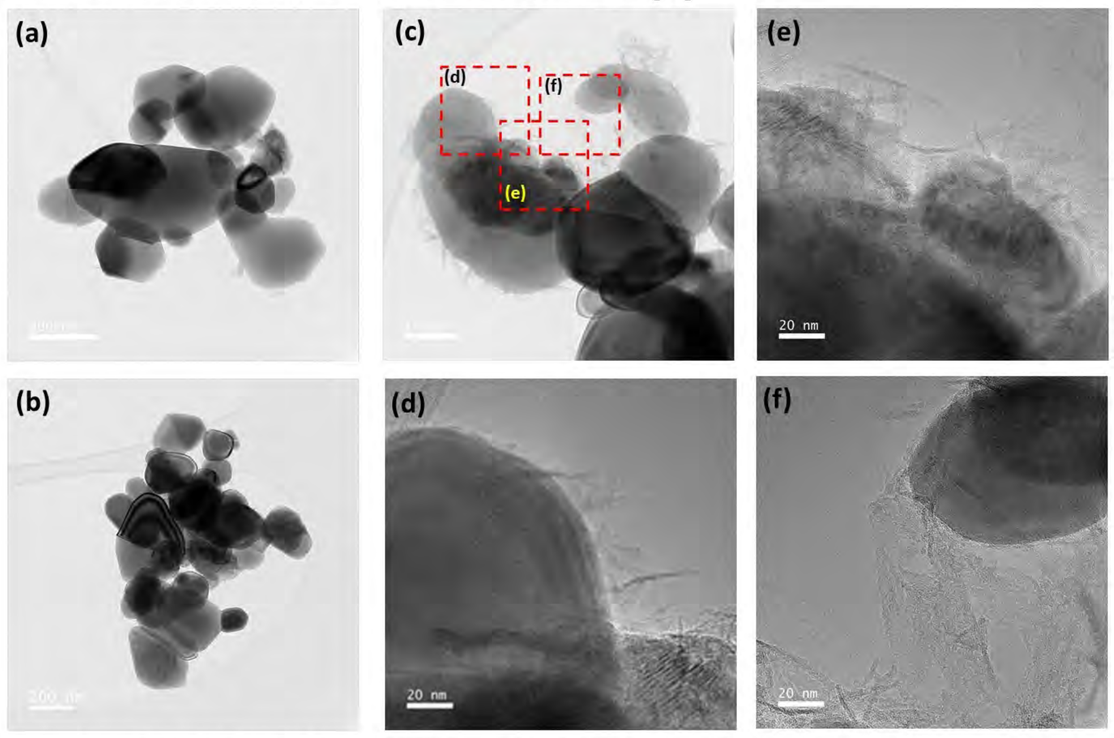
A typical pH-temperature v time profile.

Coating conditions

Stirring rate: 133 rpm (paddle stirrer)
Solids concentration: 320 g/L

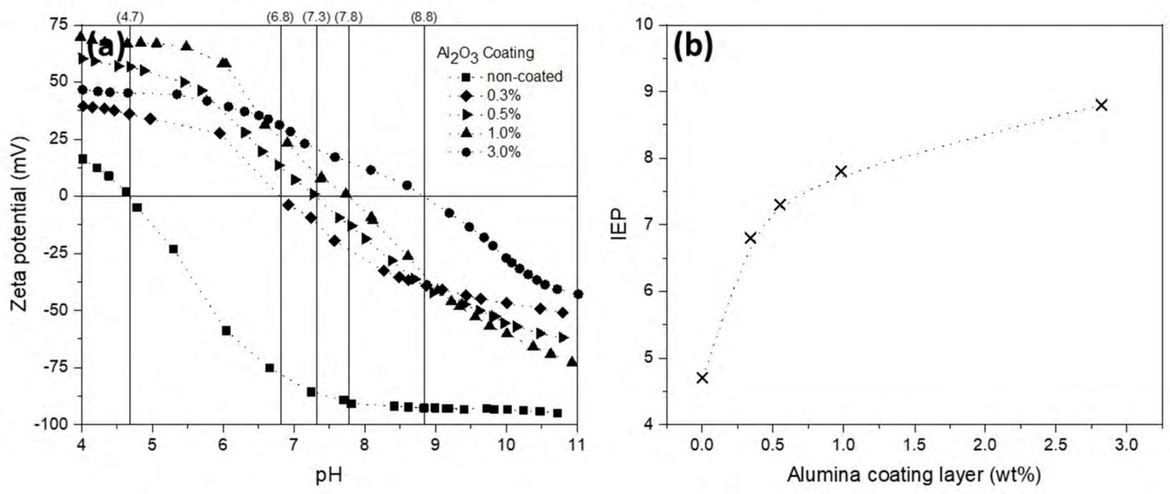
3. Characterization

Transmission electron microscopy

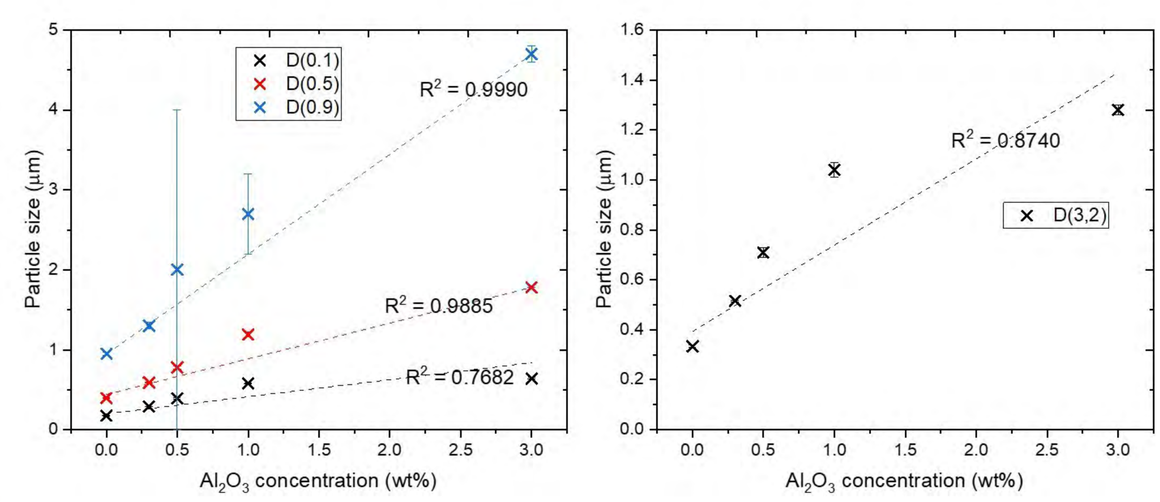


Typical examples of alumina coated TiO_2 aggregates (a-b) and alumina film morphologies (c-f).

Zeta potential measurements and iso-electric points



Particle sizing (via laser diffraction)



4. Conclusion

Precipitation of various alumina coating levels on to surface of aluminium-doped titanium dioxide (TiO_2) leads to an alteration of the particle properties.

As alumina coating level is increased, the surface of TiO_2 aggregates becomes more alumina-like in nature.

Under the preparation conditions reported, the alumina surface coating also acts as interaggregate adhesive.

References

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- Day, R.E. 1990. The role of titanium dioxide pigments in the degradation and stabilisation of polymers in the plastics industry. Polymer Degradation and Stability. 29(1), pp.73–92.

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