

# Supporting material

## **Attachment efficiency of nanomaterials to algae as an important criterion for ecotoxicity and grouping**

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1 Attachment of CeO<sub>2</sub> NM-212 to the green algae *Raphidocelis subcapitata*

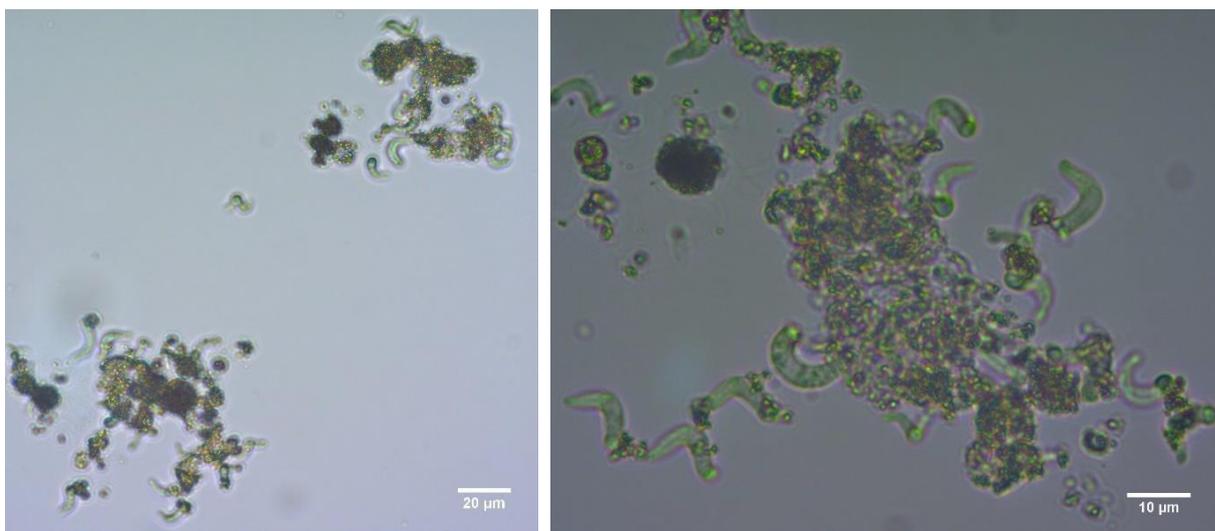


Figure S1: Attachment of CeO<sub>2</sub> NM-212 to algae. This phase-contrast image (left = 400×, right = 1000×) was captured during a 72-h growth inhibition test with 2.5 mg/L CeO<sub>2</sub> NM-212.

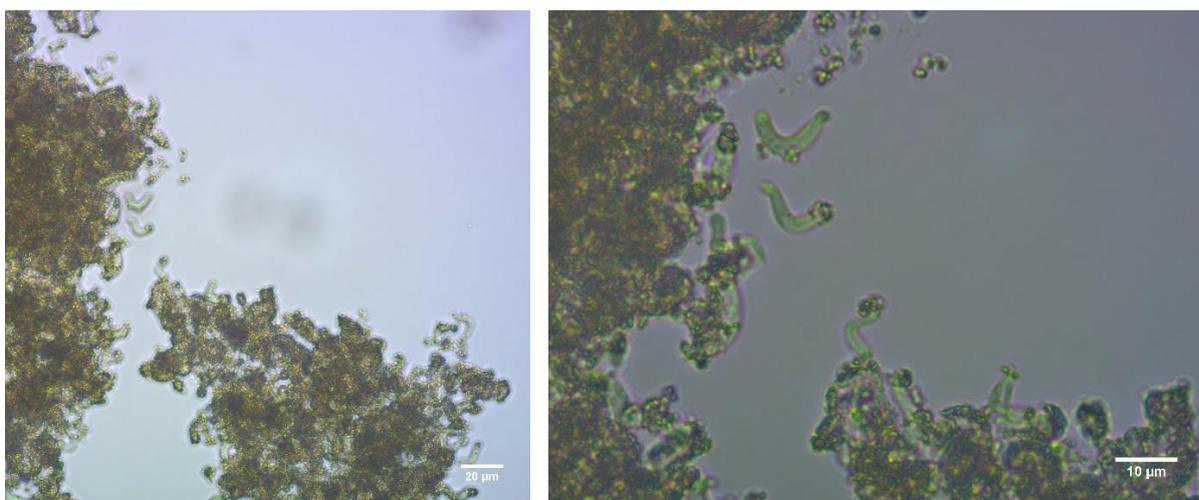
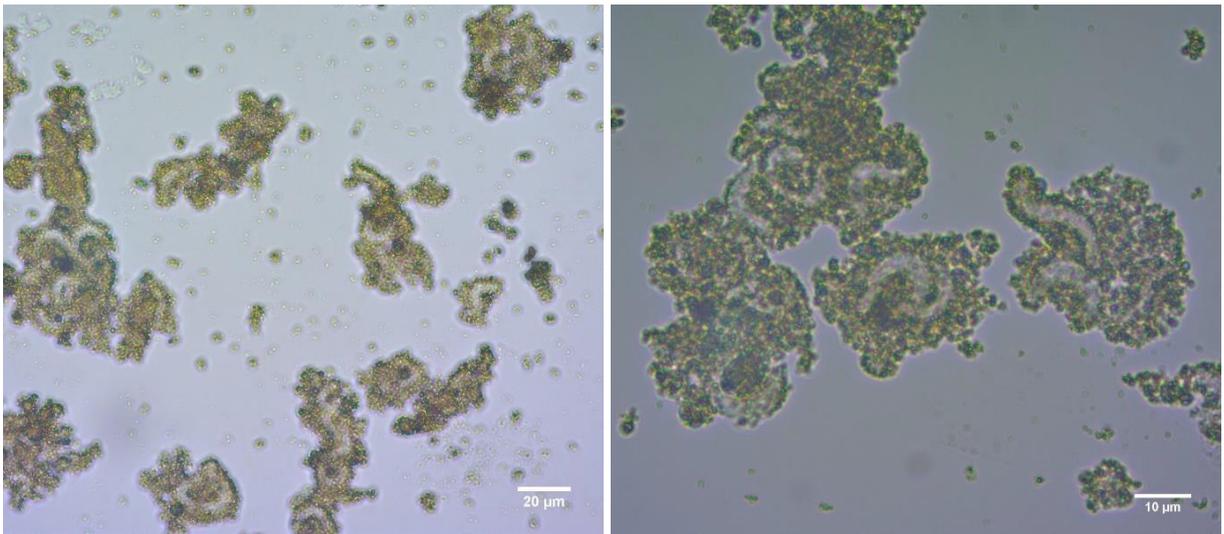


Figure S2: Attachment of CeO<sub>2</sub> NM-212 to algae. This phase-contrast image (left = 400×, right = 1000×) was captured during a 72-h growth inhibition test with 10 mg/L CeO<sub>2</sub> NM-212.



*Figure S3: Attachment of CeO<sub>2</sub> NM-212 to algae. This phase-contrast image (left = 400×, right = 1000×) was captured during a 72-h growth inhibition test with 40 mg/L CeO<sub>2</sub> NM-212.*

2 Attachment of CeO<sub>2</sub> NM-211 to the green algae *Raphidocelis subcapitata*

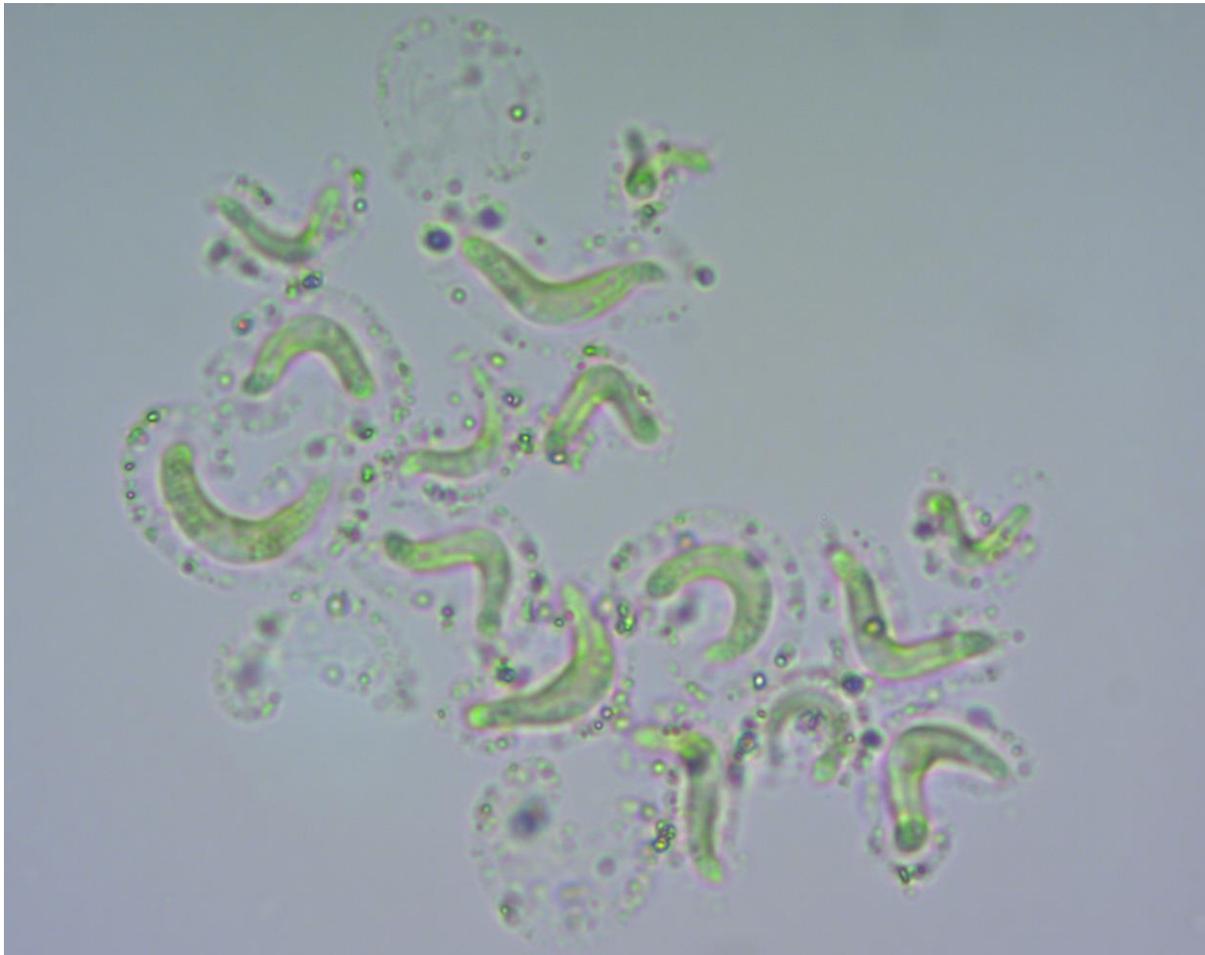


Figure S4: Attachment of CeO<sub>2</sub> NM-211 to algae. This phase-contrast image (1000× magnification) was captured after 3 h incubation with 100 mg/L CeO<sub>2</sub> NM-211.

3 Attachment of CeO<sub>2</sub> NM-213 to the green algae *Raphidocelis subcapitata*

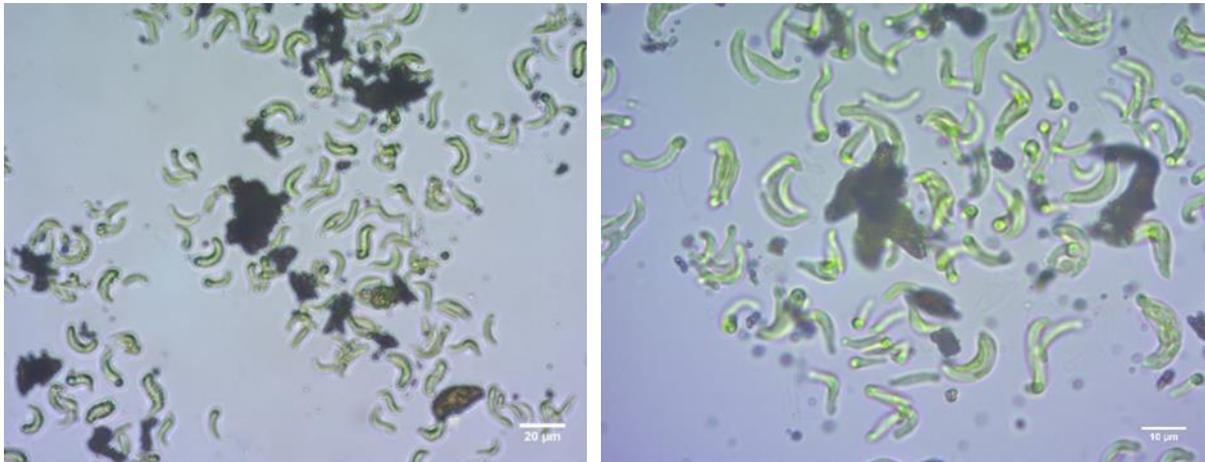


Figure S5: Attachment of CeO<sub>2</sub> NM-213 to algae. This phase-contrast image (left = 400×, right = 1000×) was captured during a 72-h growth inhibition test with 10 mg/L CeO<sub>2</sub> NM-213.

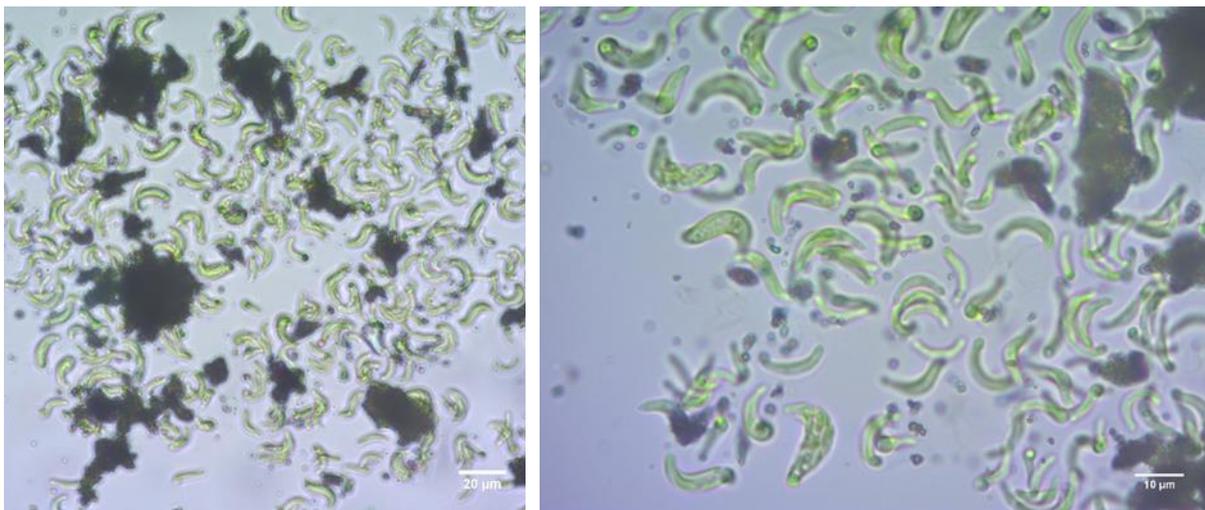
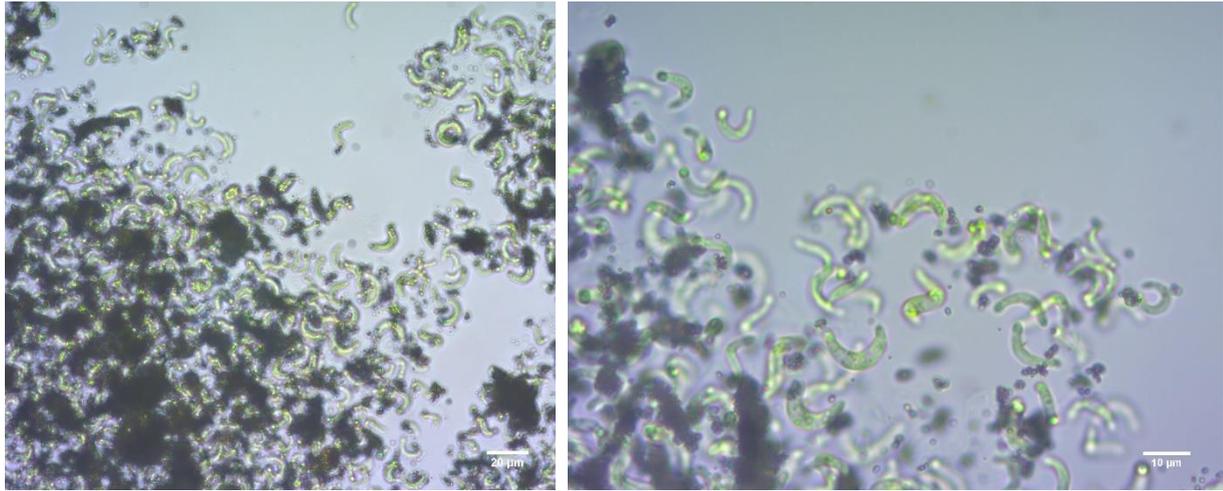
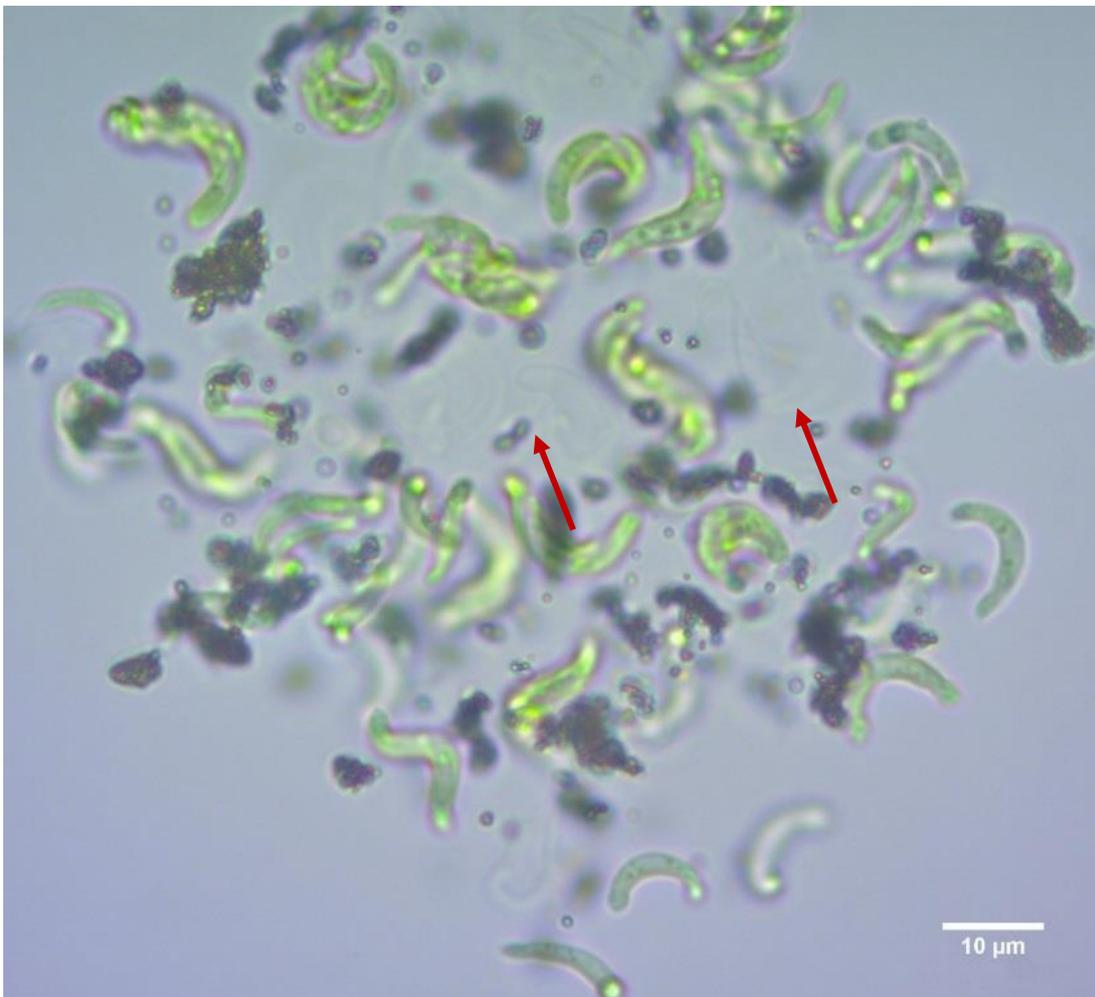


Figure S6: Attachment of CeO<sub>2</sub> NM-213 to algae. This phase-contrast image (left = 400×, right = 1000×) was captured during a 72-h growth inhibition test with 24 mg/L CeO<sub>2</sub> NM-213.



*Figure S7: Attachment of CeO<sub>2</sub> NM-213 to algae. This phase-contrast image (left = 400×, right = 1000×) was captured during a 72-h growth inhibition test with 80 mg/L CeO<sub>2</sub> NM-213.*



*Figure S8: Attachment of CeO<sub>2</sub> NM-213 to algae, showing transparent, algae-shaped structures (red arrow). This phase-contrast image (1000× magnification) was captured during a 72 h growth inhibition test with 80 mg/L CeO<sub>2</sub> NM-213.*

4 Control algae *Raphidocelis subcapitata*

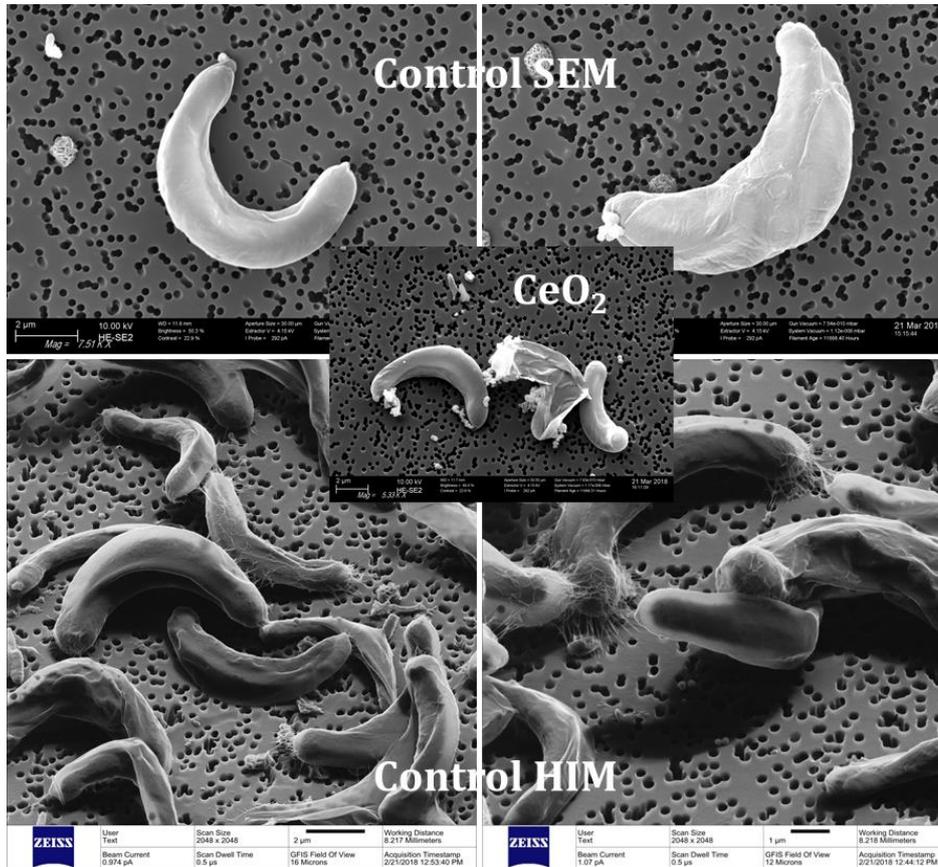


Figure S9: Control algae *Raphidocelis subcapitata*. Upper panel: scanning electron microscopy (SEM) images. Lower panel: helium ion microscopy (HIM) images. Middle insert: SEM image of CeO<sub>2</sub> NM212 exposed algae cells.

5 Attachment of  $\text{TiO}_2$  non-doped (91 % anatase; 9 % rutile) to the green alga *Raphidocelis subcapitata* – short-term test

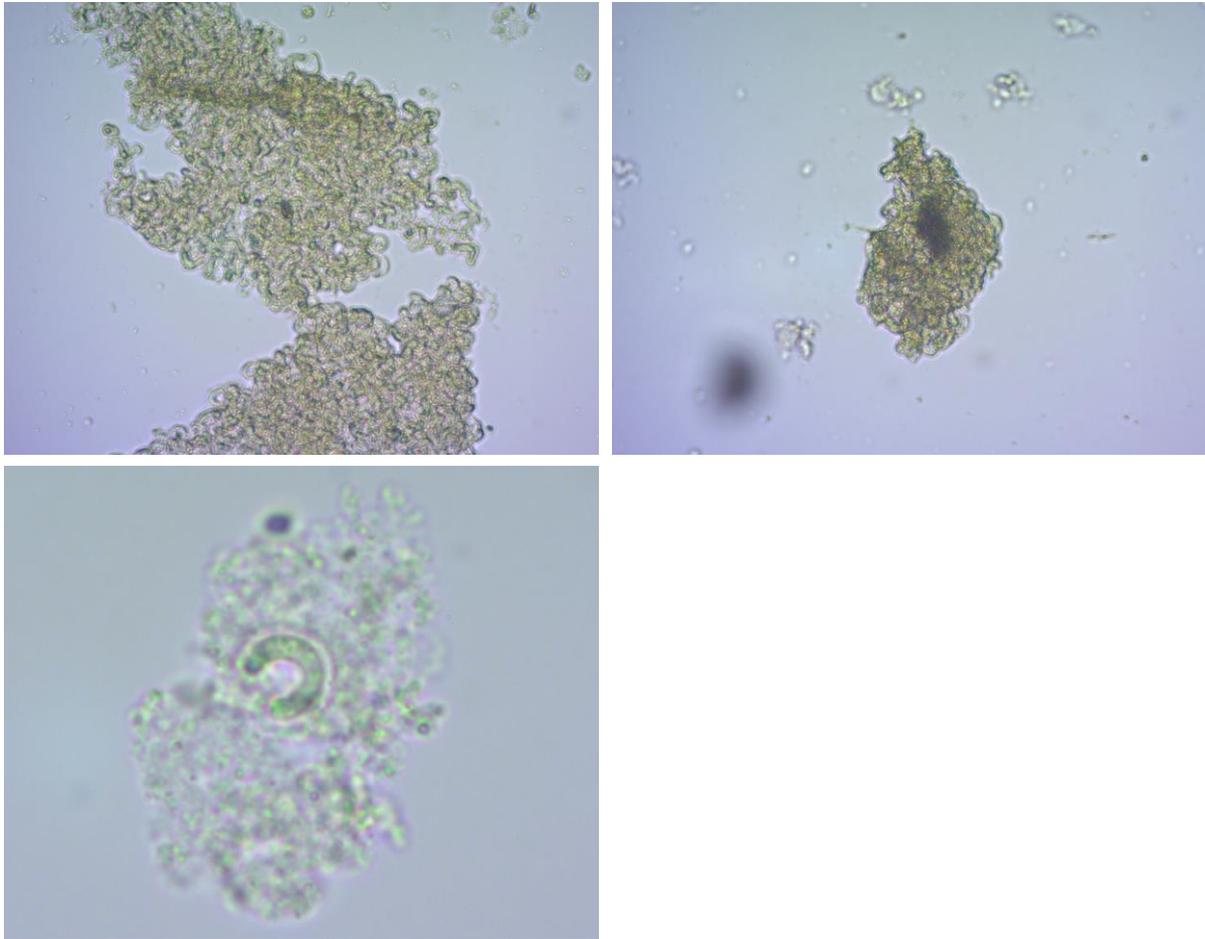


Figure S10: Attachment of non-doped  $\text{TiO}_2$  (91% anatase and 9% rutile) to algae, showing large agglomerates with embedded algal cells. This phase-contrast image (upper 400 $\times$ , lower 1000 $\times$ ) was captured after 3 h incubation with 100 mg/L non-doped  $\text{TiO}_2$ .

6 Attachment of Eu-doped TiO<sub>2</sub> to the green alga *Raphidocelis subcapitata* – short-term test

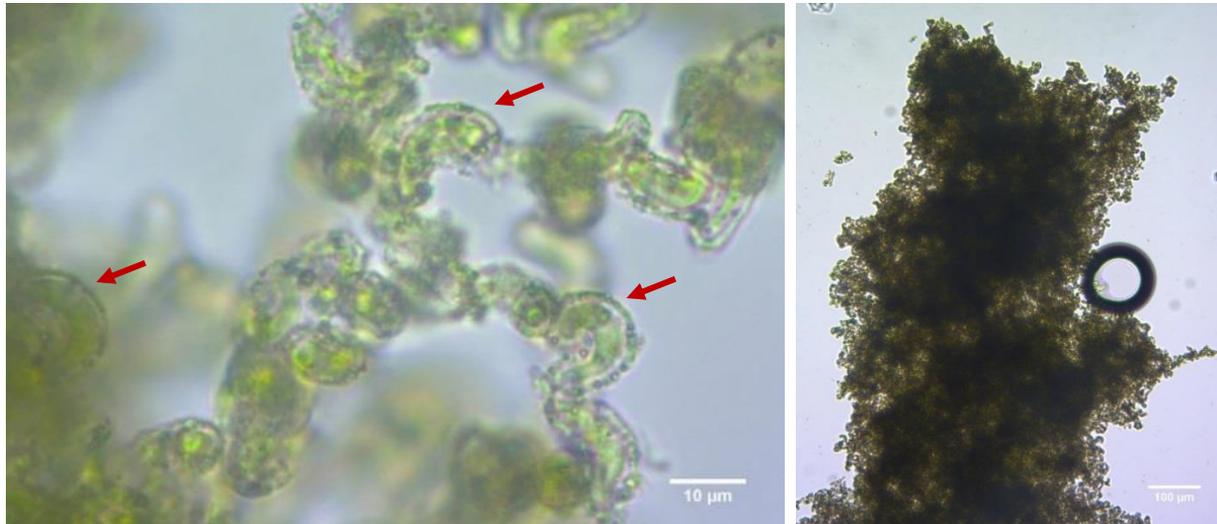


Figure S11: Attachment of Eu-doped TiO<sub>2</sub> to algae revealing attachment to transparent, sheath-like structure around algal cells (red arrow). This phase-contrast image (left = 1000 $\times$ , right = 100 $\times$ ) was captured after 3 h incubation with 100 mg/L.

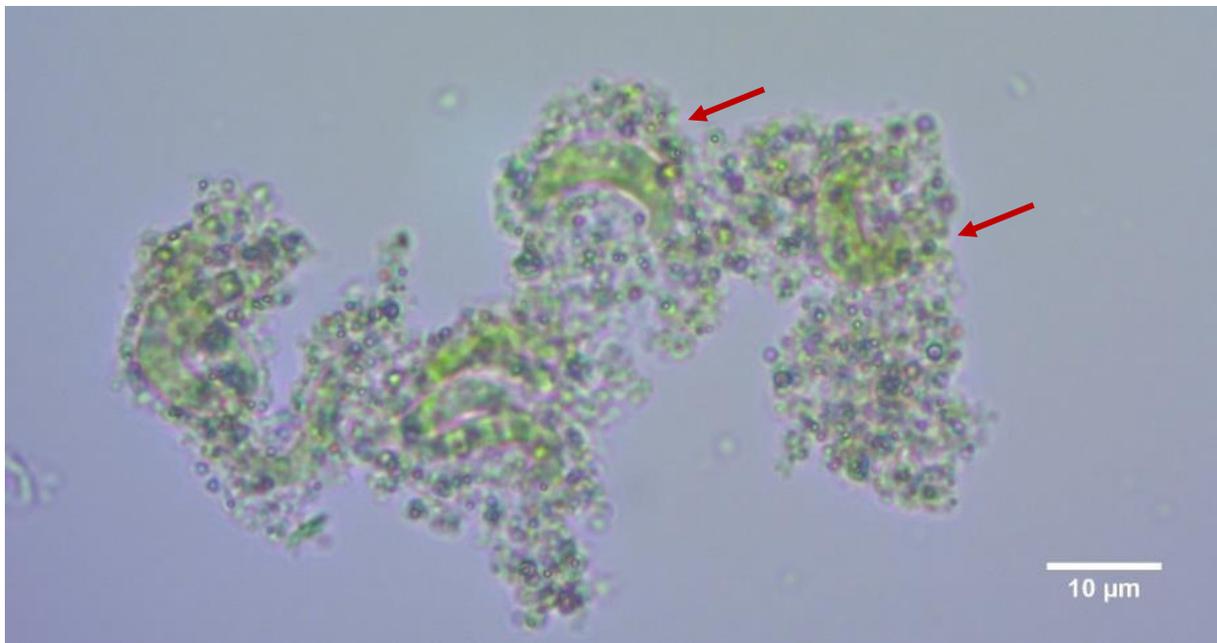


Figure S12: Attachment of Eu-doped TiO<sub>2</sub> to algae, revealing particles spread over a small area with incorporated algae cells (red arrow). This phase-contrast image (1000 $\times$  magnification) was captured after 3 h incubation with 100 mg/L Eu-doped TiO<sub>2</sub>.

7 Attachment of Fe-doped TiO<sub>2</sub> to the green algae *Raphidocelis subcapitata* – short-term test

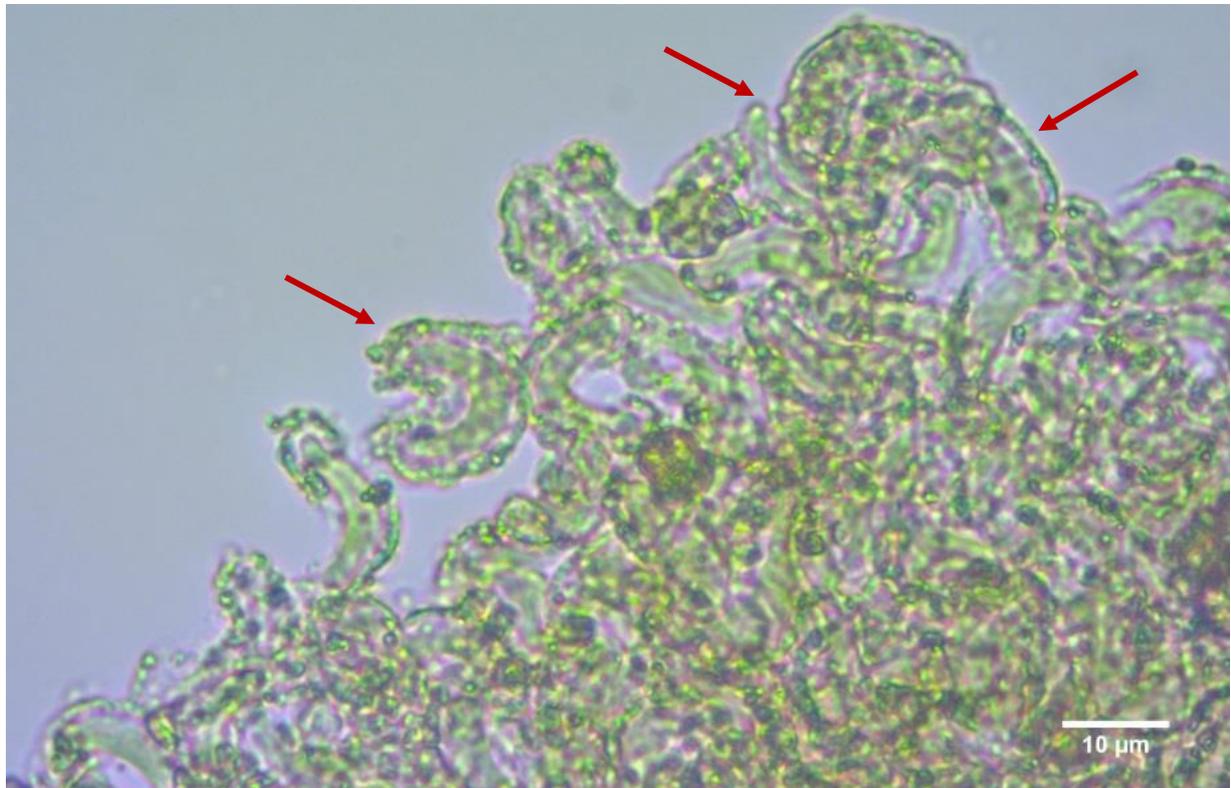


Figure S13: Attachment of Fe-doped TiO<sub>2</sub> to algae (red arrow). This phase-contrast image (1000× magnification) was captured after 3 h incubation with 100 mg/L Fe-doped TiO<sub>2</sub>.

8 Attachment of  $\text{TiO}_2$  NM-105 to the green algae *Raphidocelis subcapitata* – short-term test

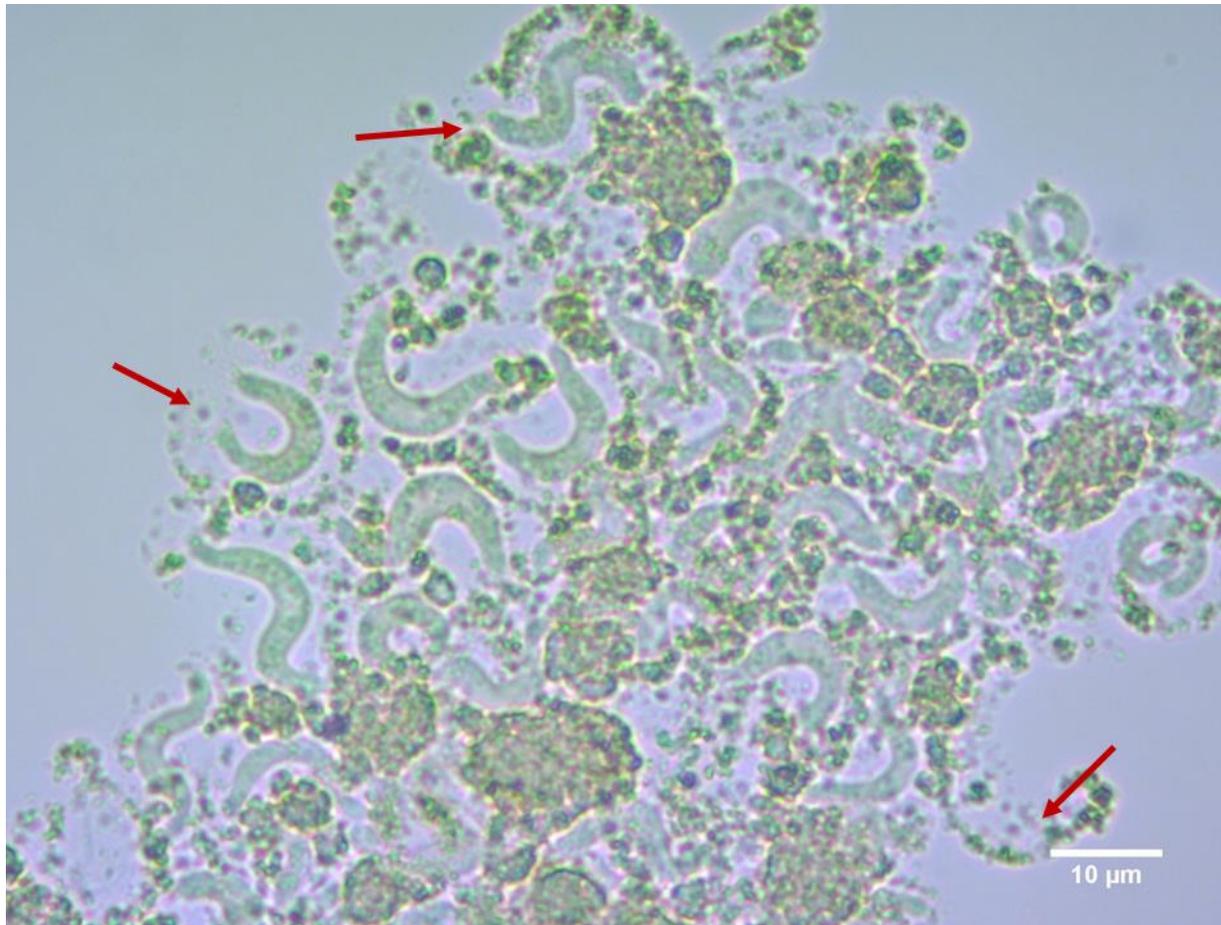
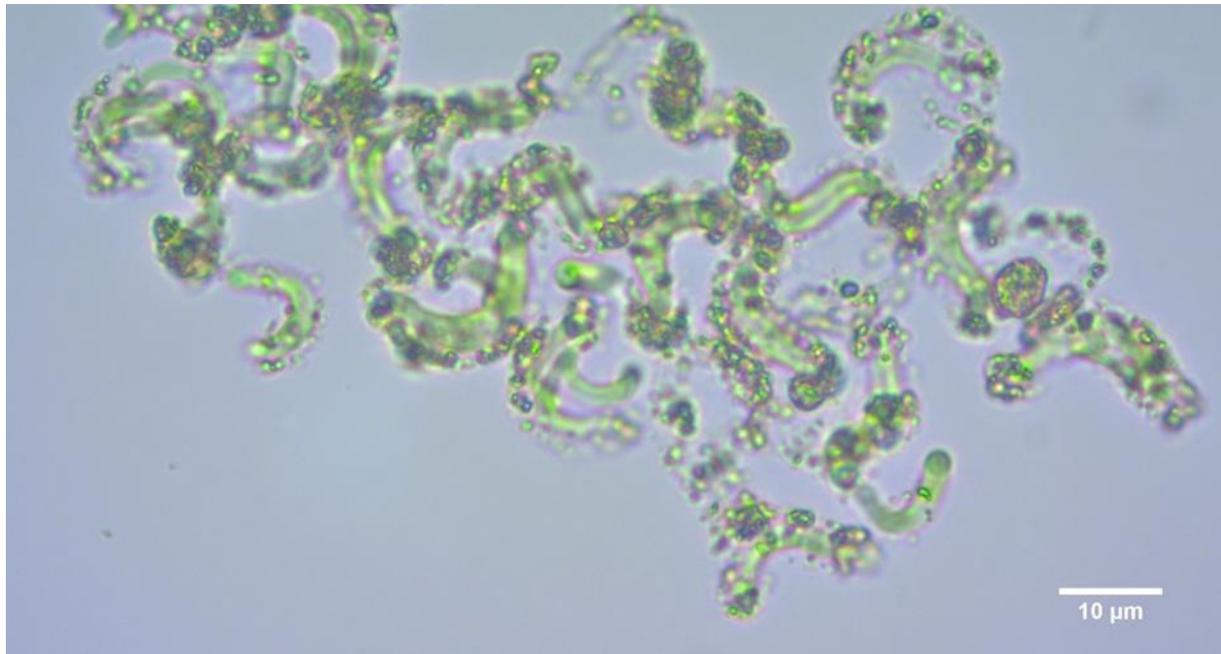


Figure S14: Attachment of  $\text{TiO}_2$  NM-105 to algae, showing nanoparticle attachment to algal cells and transparent, algae-shaped structures (red arrow). This phase-contrast image (1000 $\times$  magnification) was captured after 3 h incubation with 100 mg/L  $\text{TiO}_2$  NM-105.

9 Attachment of  $\text{TiO}_2$  NM-104 to the green algae *Raphidocelis subcapitata* – short-term test



*Figure S15: Attachment of  $\text{TiO}_2$  NM-104 to algae, showing loose formation of smaller agglomerates. This phase-contrast image (1000 $\times$  magnification) was captured after 3 h incubation with 100 mg/L  $\text{TiO}_2$  NM-104.*

1 0 Attachment of Eu-doped TiO<sub>2</sub> to the green algae *Raphidocelis subcapitata* – growth inhibition test

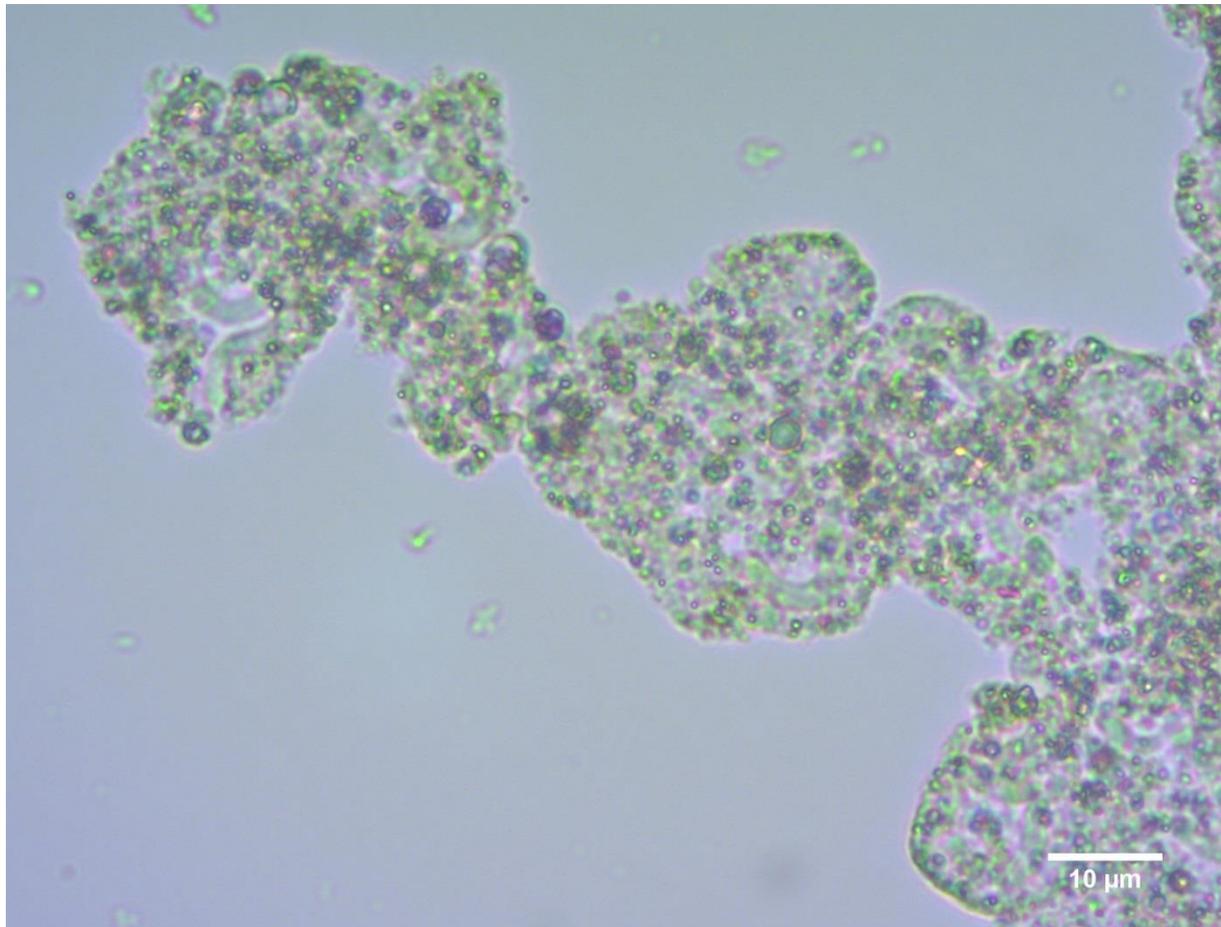


Figure S16: Attachment of Eu-doped TiO<sub>2</sub> to algae. This phase-contrast image (1000× magnification) was captured during a 72-h growth inhibition test with 2 mg/L Eu-doped TiO<sub>2</sub>.

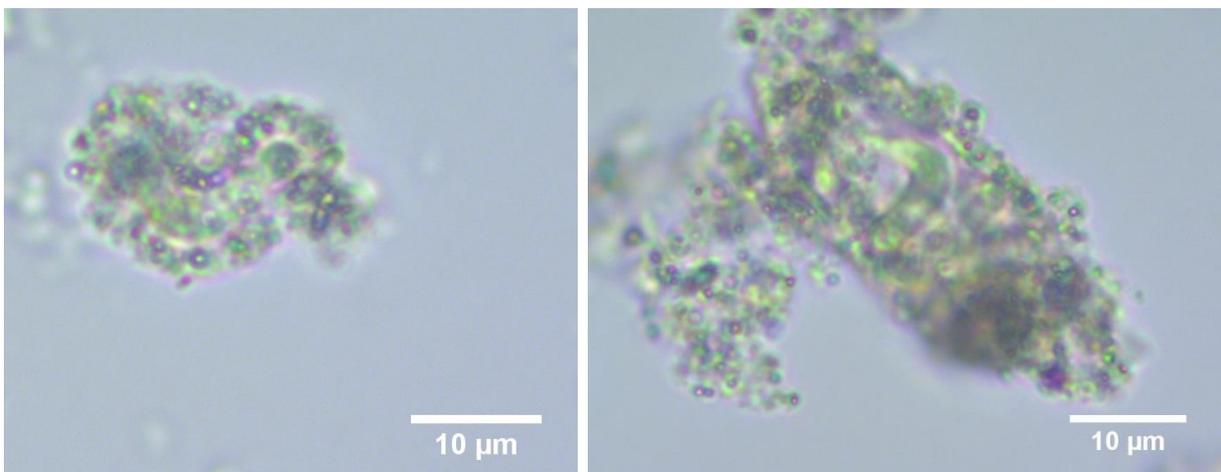


Figure S17: Attachment of Eu-doped TiO<sub>2</sub> to algae. This phase-contrast image (1000× magnification) was captured during a 72-h growth inhibition test with 18 mg/L Eu-doped TiO<sub>2</sub>.

1 1 Attachment of  $\text{TiO}_2$  NM-104 to the green algae *Raphidocelis subcapitata* – growth inhibition test

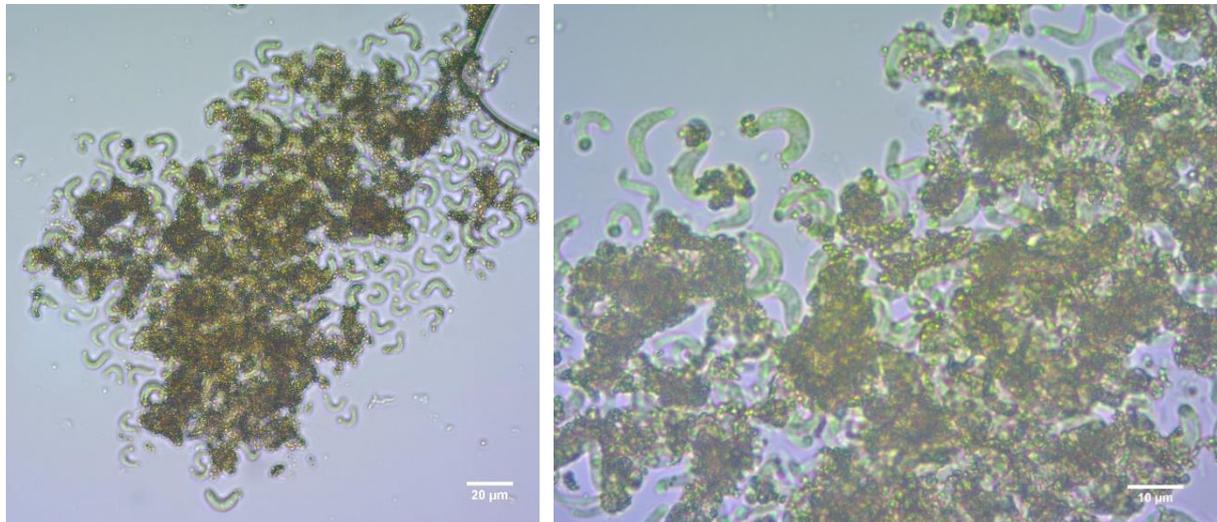


Figure S18: Attachment of  $\text{TiO}_2$  NM-104 to algae. This phase-contrast image (left = 400 $\times$ , right = 1000 $\times$ ) was captured during a 72-h growth inhibition test with 7.5 mg/L  $\text{TiO}_2$  NM-104.

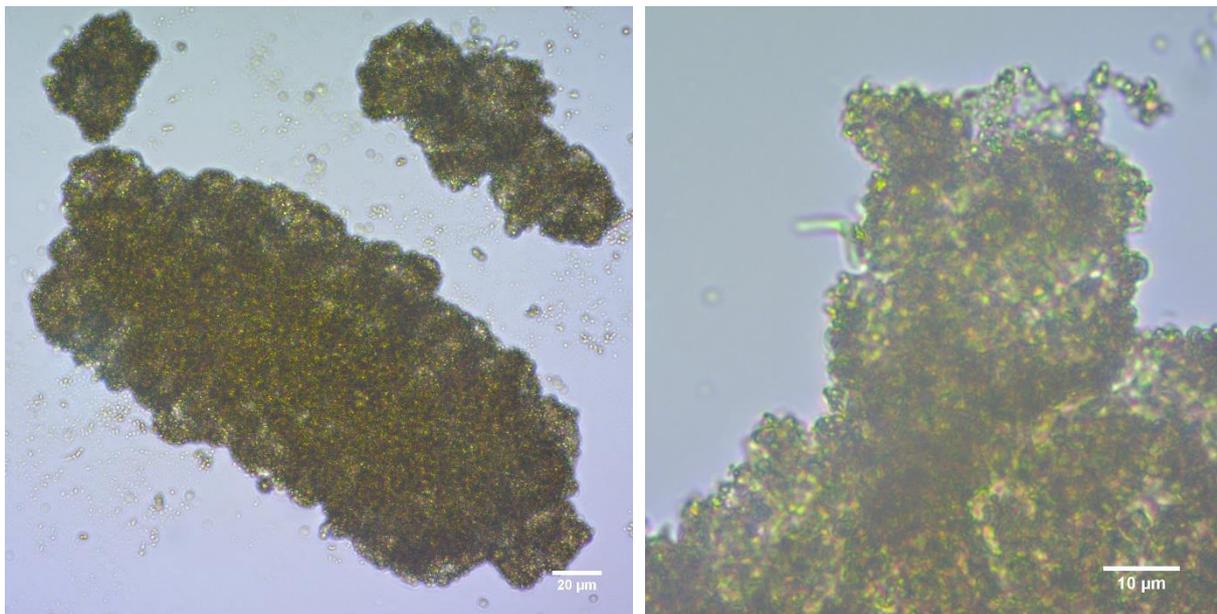
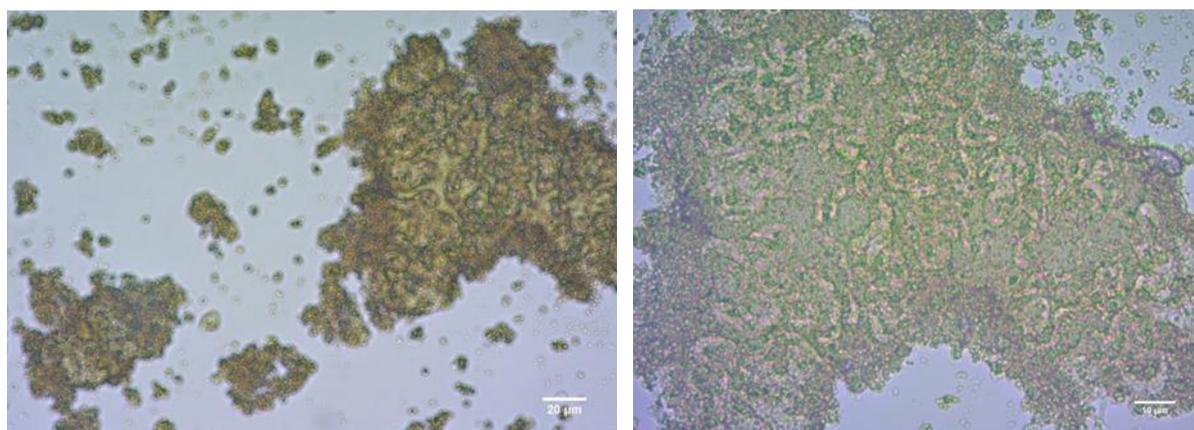


Figure S19: Attachment of  $\text{TiO}_2$  NM-104 to algae. This phase-contrast image (left = 400 $\times$ , right = 1000 $\times$ ) was captured during a 72-h growth inhibition test with 30 mg/L  $\text{TiO}_2$  NM-104.



*Figure S20: Attachment of  $\text{TiO}_2$  NM-104 to algae. This phase-contrast image (left = 400x, right = 1000x) was captured during a 72-h growth inhibition test with 120.0 mg/L  $\text{TiO}_2$  NM-104.*