

Access through your institution

Purchase PDF

Article preview

Abstract

Section snippets

References (49)

Cited by (11)



Ecotoxicology and Environmental Safety

Volume 201, 15 September 2020, 110813



# Consequences of surface coatings and soil ageing on the toxicity of cadmium telluride quantum dots to the earthworm *Eisenia fetida*

Kristi Tattai <sup>a</sup>, Thomas H. Hutchinson <sup>b</sup>, Richard D. Handy <sup>a,c</sup>

Show more

Add to Mendeley Share Cite

<https://doi.org/10.1016/j.ecoenv.2020.110813>

[Get rights and content](#)

## Highlights

- There was a coating-mediated effect on metal accumulation and toxicity of CdTe QDs.
- CdTe QDs were more hazardous than the nearest equivalent micron-sized material.
- Toxicity was not explained by Cd dissolution or the extractable Cd from the soils.
- Toxicity and reproductive effects on earthworms increased with ageing of the soil.
- Cd and Te accumulation from CdTe QDs was higher in aged compared to fresh soil.

## Abstract

The **bioaccumulation** potential and toxic effects of engineered **nanomaterials** (ENMs) to earthworms are poorly understood. Two studies were conducted following OECD TG 222 on *Eisenia fetida* to assess the effects of CdTe QDs with different coatings and soil ageing respectively. Earthworms were exposed to carboxylate (COOH), ammonium (NH<sub>4</sub><sup>+</sup>), or **polyethylene glycol** (PEG) coated CdTe QDs, or a micron scale (bulk) CdTe material, at nominal concentrations of 50, 500 and 2000 mg CdTe QD kg<sup>-1</sup> dry weight (dw) for 28 days in Lufa 2.2 soil. In the fresh soil study, earthworms accumulated similar amounts of Cd and Te in the CdTe-bulk exposures, while the accumulation of Cd was higher than Te during the exposures to CdTe QDs. However, neither the total Cd, nor Te concentrations in the earthworms, were easily explained by the extractable metal fractions in the soil or particle dissolution. There were no effects on survival, but some retardation of growth was observed at the higher doses. Inhibition of Na<sup>+</sup>/K<sup>+</sup>-ATPase activity with disturbances to tissue electrolytes, as well as tissue Cu and Mn were observed, but without depletion of total **glutathione** in the fresh soil experiment. Additionally, juvenile production was the most sensitive endpoint, with estimated nominal EC<sub>50</sub> of values >2000, 108, 65, 96 mg CdTe kg<sup>-1</sup> for bulk, PEG-, COOH- and NH<sub>4</sub><sup>+</sup>-coated CdTe QDs, respectively. In the aged soil study, the accumulation of Cd and Te was higher than in the fresh soil study in all CdTe QD exposures. Survival of the adult worms was reduced in the top CdTe-COOH and -NH<sub>4</sub><sup>+</sup> QD exposures by 55 ± 5 and 60 ± 25%, respectively; and with decreases in growth. The nominal EC<sub>50</sub> values for juvenile production in the aged soil were 165, 88, 78 and 63 mg CdTe kg<sup>-1</sup> for bulk, PEG-, COOH- and NH<sub>4</sub><sup>+</sup>-coated CdTe QDs, respectively. In conclusion, exposure to nanoscale CdTe QDs, regardless of coating, caused more severe toxic effects than the CdTe bulk material and the toxicity increased after soil ageing. There were some coating-mediated effects, likely due to differences in the metal content and behaviour of the materials.

Recommended articles

Predicting oxidative stress induced by organic chemicals by using quantitative...

Ecotoxicology and Environmental Safety, Volume 201, ...  
Shengnan Zhang, ..., Yuanhui Zhao

Superparasitism by a parasitoid wasp: The absence of sublethal effects from the...

Ecotoxicology and Environmental Safety, Volume 201, ...  
Jean-Marie Delgouech

Bioinspired carbon quantum dots for sensitive fluorescent detection of vitamin...

Analytica Chimica Acta, Volume 1032, 2018, pp. 154-162  
Mingyan Wang, ..., Jian Shen

Show 3 more articles

Article Metrics

Citations

Citation Indexes: 11

Captures

Readers: 20



[View details](#)