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**Regulation of deprotonation of 3,3-di(1H-tetrazol-5-yl)pentanedioic acid: solvothermal synthesis of La(III) and heterometallic La(III)/Cu(II) compounds for ablation of A549 cells**

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**Abstract**

3,3-di(1H-tetrazol-5-yl)pentanedioic acid (H<sub>4</sub>dtzpda) can display tunable valence when reacted with different metal ions because it has four acidic hydrogen atoms of both tetrazole rings and carboxylate groups. Solvothermal reactions of H<sub>4</sub>dtzpda with La(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O or La(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O/Cu(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O afforded a one dimensional [La(Hdtzpda)(H<sub>2</sub>O)<sub>4</sub>]·4H<sub>2</sub>O (1) and a three dimensional [La<sub>2</sub>Cu(dtzpda)<sub>2</sub>(H<sub>2</sub>O)<sub>10</sub>]·4H<sub>2</sub>O (2), respectively, where only three acidic hydrogen atoms of H<sub>4</sub>dtzpda are deprotonated in compound 1 while all the four acidic ones are deprotonated in compound 2. In compound 1, Hdtzpda<sup>3-</sup> is a penta-dentate ligand to bridge La(III) centers *via* only oxygen atoms of the carboxylate group while in compound 2, dtzpda<sup>4-</sup> is a hepta-dentate one *via* not only the oxygen atoms of the carboxylate group but also the nitrogen atoms of the tetrazole rings. PEG-<sub>5000</sub> (poly(ethyleneglycol-<sub>5000</sub>)) coated compound 1 or 2 nanoparticles (NPs) have good

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