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# LHT-9: A lepidocrocite-type layered nano-material with applications in radioactive waste treatment

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Layered hydrazinium titanate is a layered material with a lepidocrocite-type structure having an interlayer distance of about 9Å, hence the acronym. It can be synthesized under mild conditions by a simple one-pot method. Its idealized formula is $(N_2H_5)_{0.5}Ti_{1.87}O_4$, it crystallizes in space group Immm, with a $\approx$ 3.8 Å, b $\approx$ 18.46 Å, c $\approx$ 2.98 Å. Under the correct conditions it forms as a nano-crystalline material which, however, has important non-periodic structural features. It has been characterized by various methods, notably HRTEM, XRD, IR spectroscopy with analysis of gas evolution upon heating, XANES and EXAFS. The analyses have revealed that LHT-9 consists of bent and deformed nano-flakes with only a few layers thickness, a high concentration of titanyl-groups and Brønsted-sites at the surface, and chemically bound hydrazinium $(N_2H_5)^+$ in the interlayers. The reductive properties of hydrazinium together with the structural characteristics of the titanate matrix determine the remarkable properties of LHT-9 and make it a valuable tool kit for many applications. More than 50 elements of the periodic table have been shown to be reduced, adsorbed and/or ion exchanged by LHT-9 [1, 2]. In particular, it could be shown that various radioactive species, such as U, Mo, Cs, Sr, lanthanides, or Tc can be removed from waste waters or combustion gases. $TcO_4^-$ is reduced to $Tc^0$ and absorbed on LHT-9. Sintering results in a dense ceramic consisting of a mixture of rutile and hollandite, both of which show substitution of Tc for Ti. At present test experiments with real radioactive waste streams are in preparation, the results of which will be reported.

[1] S. N. Britvin, S. V. Krivovichev, W. Depmeier, O. I. Siidra, D. V. Spiridonova, V. V. Gurzhiy, A. A. Zolotarev, PCT Patent Application PCT/EP2010/001864 filed March 25, 2010.
[2] S. N. Britvin, A. Lotnyk, L. Kienle, S. V. Krivovichev, W. Depmeier|| J. Am. Chem. Soc. 2011, 133, 9516–9525