Studies of cellular lead uptake using a rhodamine-based fluorescent probe

Lead is a toxic metal that naturally occurs in the Earth's crust and is distributed throughout the environment, which has long been known to have toxic effects on the body. While it is lead's systemic effects that are most widely studied, much remains to be learnt about the cellular uptake of lead. We report here a rhodamine-based fluorescent probe, RPb1, that undergoes a 100-fold increase in fluorescence emission in the presence of Pb^{2+}. RPb1 has good selectivity and excellent reversibility for the detection of Pb^{2+}, and we have demonstrated its capability of sensing Pb^{2+} both in vitro and in mammalian living cells.

We further investigated cellular uptake of Pb^{2+} in two different cell models. We found that the uptake of Pb^{2+} as well as labile Pb^{2+} in DLD-1 cells is temperature-dependent and that labile Pb^{2+} decreases while total lead levels remain unchanged as K562 cells become more differentiated. RPb1 is therefore likely to be of utility in elucidating labile lead pool in cells. We have demonstrated the value of using complementary techniques such as flow cytometry studies with RPb1, ICP-MS and SC-ICP-MS for studying labile and protein-bound lead in cells. The number of lead atoms in individual K562 cells was also determined with SC-ICP-MS: this technique has been reported for the study of cellular lead content for the first time.