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Characterization of zinc vapor condensation in fly ash particles using synchrotron X-ray absorption spectroscopy

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Research highlights

- Synchrotron X-ray absorption spectroscopy was used to investigate metal speciation.
- Zn speciation in sized fly ash particles (<9.8 μm) collected from hot flue-gases after the heat recovery unit and before APC system are analyzed with XANES and EXAFS spectroscopy.
- The changes in Zn species during flue gas cooling process were described.
- Very different Zn speciation was found in the ash samples from the two furnace types.

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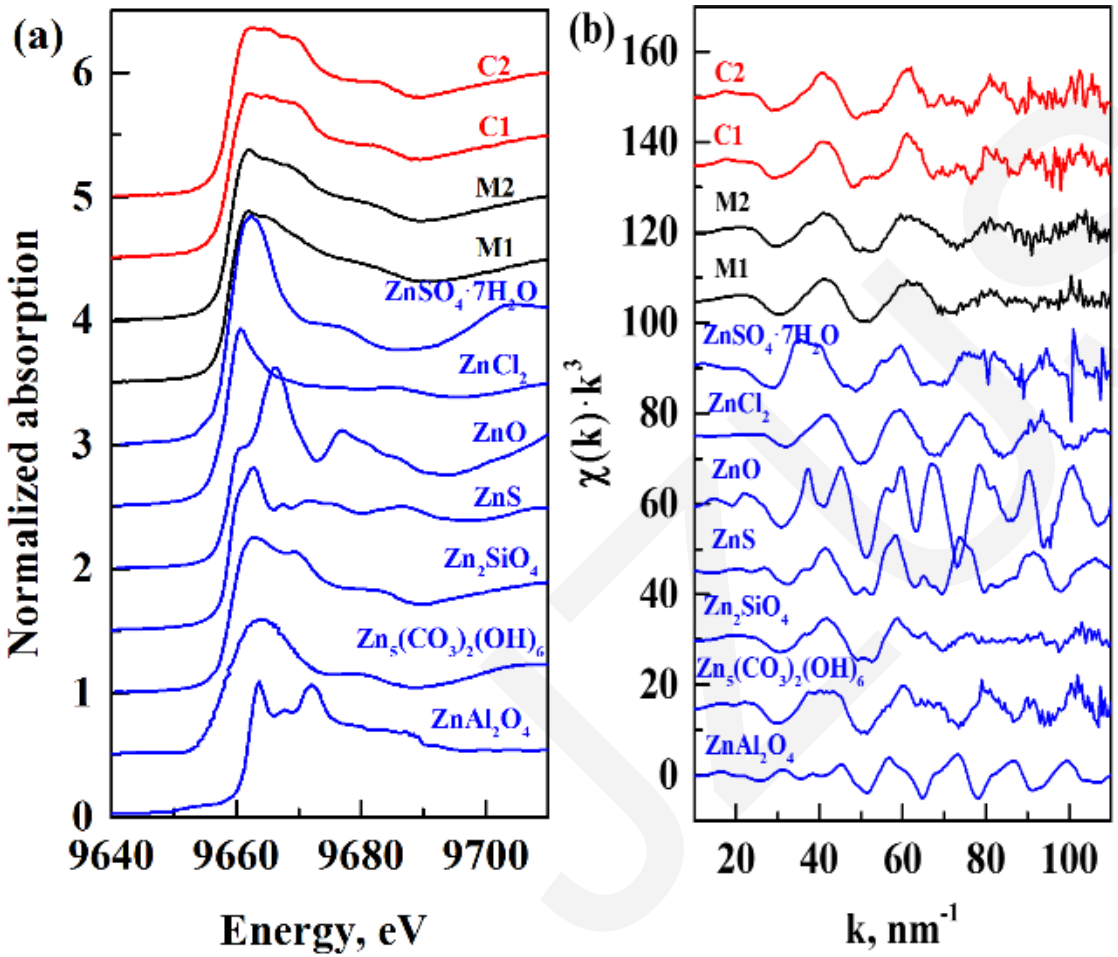
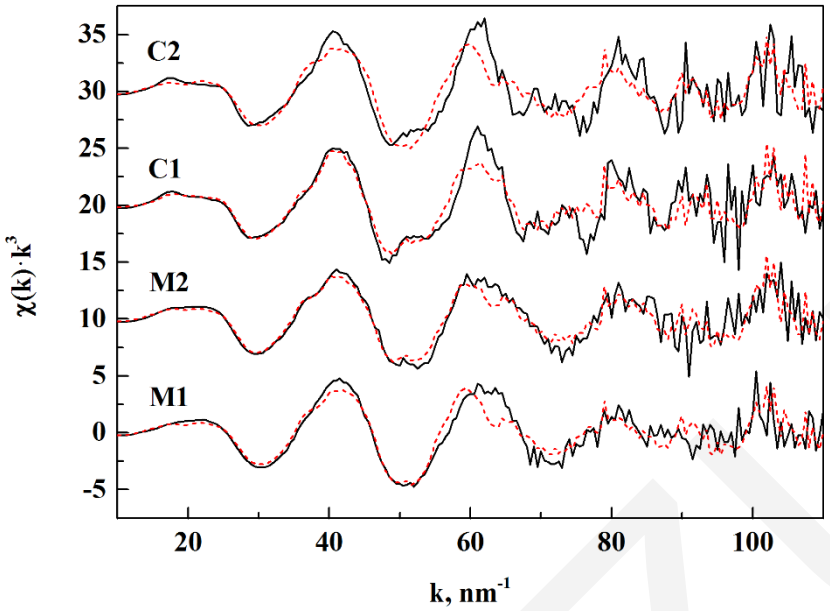
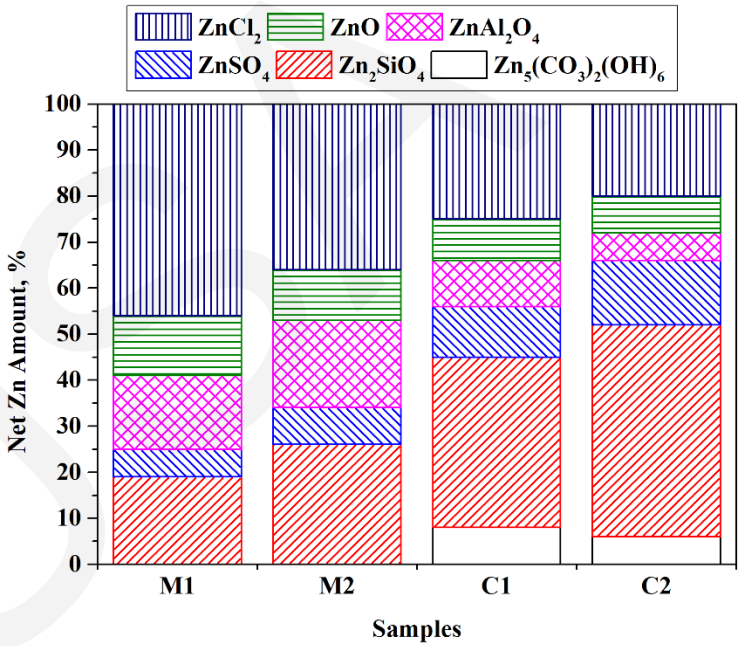
X-ray absorption spectroscopy measurements



▸ the condensation of zinc vapor during flue-gas cooling in a 200 t/d fluidized bed incinerator and a 150 t/d moving grate incinerator was characterized and comparatively studied using high resolution synchrotron X-ray absorption spectroscopy.

Major results





- Principal component analysis, target transformation, and linear combination fitting were employed to identify zinc species directly from size fractionated fly ash particles.
- The chemical reaction behaviors of different zinc species were described by thermodynamic equilibrium simulations.

Conclusions

▸zinc chloride is the major species in fly ash collected from the moving grate system, and willemite dominates in the CFB system.

▸ The ratio of S/Cl can alter the condensation propensity of Zn.

▸ Silica, alumina, aluminosilicates and calcium-based compounds are potential sorbents for transforming zinc to an environmentally benign form.

▸wet scrubbers are more suitable for cleaning flue-gases in moving grate incineration systems, while increasing dust removal efficiency is more important for fluidized bed incineration systems.