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Review

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## Synthesis of Nanoporous Materials via Recycling Coal Fly Ash and Other Solid Wastes: A Mini Review

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### Abstract

Large quantities of fly ash are discharged as a by-product from coal power plants. Therefore, an effective method to recycle this waste material is necessary. In this regard, the high silica content of fly ash makes it a potential useful source for the synthesis of nanoporous materials, such as zeolites, mesoporous silica or silica aerogels. In this mini review, zeolite synthesis from fly ash was examined by considering the ash composition, pretreatment procedures, and hydrothermal synthesis conditions (substrate composition and synthesis temperature/time) to identify an optimal set of synthesis conditions. These zeolites can be used as adsorbents and ion-exchangers for environmentally hazardous materials including those present in the fly ash itself. The synthesis of mesoporous silica materials with a high surface area and large pore volume derived from fly ash was next assessed for their use as a support and as a surface-functionalized host for capturing the global warming CO<sub>2</sub> and rare earth metal ions. Lastly, the utilization of fly ash for the preparation of silica aerogels or adiabatic foams, which are being considered as a potential building insulation materials, was briefly examined. Cases of synthesizing these nanoporous materials using other solid wastes as silica and/or alumina sources were also examined. The synthesis of diverse porous materials utilizing the waste sources would enable a high level of recycling for a sustainable society with a low environmental burden.

**Keywords:** fly ash; recycling; zeolites; mesoporous materials; aerogel; adiabatic foam

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