

PROJECT FACTS

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CARBON MATERIALS

Development of Fire-Resistant Materials for Building Coverings

Every year grass and forest fires destroy a great deal of real estate and infrastructure. These losses are not restricted to the western regions of the country, but are suffered by homeowners in nearly every state in the US. One important means by which structures are ignited is through wind-blown embers burning through the roof-covering material, most commonly asphalt shingles. Steel roofing is not flammable, but the thermal conductivity is very high so the underlying material can be ignited. Slate tile, ceramic tile, concrete composite materials, and terra cotta are much better, but tend to be heavy and are undesirable in earthquake-prone areas (such as California).

We have investigated the potential application of carbon foam as a fire resistant building covering material. Carbon foam is typically lightweight (density < 0.6 g/mL) and is highly resistant to oxidation. The thermal conductivity of these foams can be low or high, depending on the heat treatments used in manufacturing, and this ensemble of characteristics makes carbon foam a potential base material for fire-resistant shingles, siding, and other coverings.

The high porosity of foams is a liability in exterior applications. Infiltration of water into carbon foam is undesirable for several reasons. Most importantly, freeze-thaw cycles over the seasons can destroy porous materials. A number of different coatings could be used to prevent water infiltration, but we have concentrated on coatings that can match the thermal- and oxidation-stability of the carbon foam.

We have found that a variety of different coatings, including ceramic glazes and glassy carbons, provide an excellent degree of water repellency without compromising the fire resistance of the material. Thin plates of carbon foam (~1/4" thick) were dipped in glaze slurry and fired, resulting in a prototype shingle that withstood a dozen freeze-thaw cycles without detectable degradation. These glazes also provide an attractive range of colors and textures. Flame tests have demonstrated that these shingles are impervious to intense fires that quickly liquefy and ignite asphalt shingles. Further work is underway to improve the properties necessary for use of these materials in real-world situations.



A sample of 6" square roofing tile made from Koppers L-foam, coated with a commercial ceramic glaze.