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### Abstract:

The effective piezoelectric properties of the cement-based 2-2 type piezoelectric composites have been investigated both experimentally and theoretically. The two-scale asymptotic expansion method is employed to develop a homogenized model for the effective properties calculation. The validity of the theoretical solution is confirmed through the comparison with the experimental results. The influence of the volume fraction of the piezoelectric phase on the effective piezoelectric coefficients is then examined. It is found that higher volume fraction will induce obvious increment of the magnitude of the effective piezoelectric strain coefficients  $d_{31}^{\text{Eff}}$ ,  $d_{32}^{\text{Eff}}$ , and  $d_{33}^{\text{Eff}}$ , however, the hydrostatic piezoelectric strain coefficient  $d_h^{\text{Eff}}$  will reach a maximum value at a lower volume fraction.

*Keywords:* Effective piezoelectric properties; Cement-based 2-2 type piezoelectric composites; Asymptotic expansion method

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