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Maximizing electrophoretic mobility differences among polymorphic materials

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Physical separation of different polymorphs is a serious experimental challenge, but success would help efforts in applications as diverse as drug discovery, environmental remediation, and cultural conservation. To meet this challenge, we demonstrate a proof-of-principle method to separate polymorphic materials by tuning their electrophoretic mobility differences. Our test case involved two different phases of calcium carbonate (aragonite and calcite, both CaCO₃) in aqueous suspensions. Two serendipitous benefits arose when we used conventional additives in the suspension to prevent particle aggregation. First, phosphate-based additives increase the magnitude of the electrophoretic mobility differences between calcite and aragonite. This is advantageous because the greater the electrophoretic mobility difference, the less time and distance would be required for polymorph separation. Second, the phosphate additives prevent aragonite dissolution, even when the particles remain in aqueous suspension for many months. This is very fortuitous because it makes electrophoresis a non-destructive separation strategy for these calcium carbonate polymorphs.

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