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John H. Dillon Medal Talk: Solvent Annealing of Water-Dispersible Polyaniline Yields Highly Conductive Functional Components for Organic Electronics

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Though highly conductive, early conducting polymers are neither melt- nor solution processable due to their extensive conjugation. To overcome this intractability, macromolecular dopants have been employed to render conducting polymers water dispersible. The gain in processability, however, has frequently come at the expense of conductivity. With a simple solvent annealing treatment, we have dramatically improved the conductivity of water-dispersible conducting polymers; the conductivities achieved through this treatment qualify water-dispersible conducting polymers as practical alternatives for metals and transparent metal oxides as electrodes in organic thin-film transistors and organic solar cells. Specifically, solvent annealing induces structural rearrangement; polyaniline transforms from a globular structure that is arrested by strong ionic interactions with its macromolecular dopants to an expanded structure that is conformationally more favorable. It is this structural transformation that increases the electrical conductivity of polyaniline by more than two orders of magnitude.