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Radical technological innovations are needed to achieve sustainability, but such innovations confront unusually high barriers, as they often require sociotechnical transitions. Here we use the theoretical perspectives and methods of Science and Technology Studies (STS) to demonstrate ways that existing theories of innovation and sociotechnical transitions, such as the Multi-Level Perspective (MLP), can be expanded. We test the MLP by applying STS methods and concepts to analyze the history of aircraft composites (lightweight materials that can reduce fuel consumption and greenhouse gas emissions), and use this case to develop a better understanding of barriers to radical innovation. In the MLP, "radical innovation" occurs in local niches—protected spaces for experimentation—and is then selected by a sociotechnical regime. The history of composite materials demonstrates that radical innovation could not be confined to "niches," but that the process of scaling up to a wholly new product itself required radical innovation in composites. Scaling up a process innovation to make a new product itself required radical innovation. These findings suggest a need to refine sociotechnical transitions theories to account for technologies that require radical innovation in the process of scaling up from the level of sociotechnical niche to regime.

Graphical abstract



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