The Hirao Reaction: Palladium-Catalyzed Cross-Coupling of Dialkyl Phosphites with Aryl Halides

Selected examples:

- \( R = \text{H} \): 92% yield
- \( R = \text{Me} \): 94% yield
- \( R = \text{MeO} \): 95% yield
- \( R = \text{Cl} \): 85% yield
- \( R = \text{Br} \): 81% yield
- \( R = \text{NO}_2 \): 73% yield
- \( R = \text{CN} \): 95% yield

Significance: In 1981, Hirao and co-workers disclosed the direct cross-coupling of aryl halides with dialkyl phosphites in the presence of a palladium(0) catalyst and an amine base to give the corresponding aryl phosphonates. In contrast to the Michaelis–Arbuzov reaction, this protocol enables the facile formation of C(sp\(^2\))–P bonds.

Comment: While most products were isolated in good to excellent yields, the cross-couplings of para-hydroxyphenyl and para-aminophenyl halides were ineffective. The substrate scope was successfully extended to vinyl halides (Tetrahedron Lett. 1980, 21, 3595), affording the corresponding vinyl phosphonates in high yields (see grey box).