In 1954, Georg Wittig (then at the University of Tubingen) reported a method of synthesizing alkenes from carbonyl compounds, which amounts to the replacement of carbonyl oxygen, =O by the group =CRR'. The heart of the synthesis is the nucleophilic attack on carbonyl carbon by an ylide to form a betaine which—often spontaneously—undergoes elimination to yield the product.

For example:

\[
\begin{align*}
\text{benzophenone} + \text{Ph}_3\text{P=CH}_2 & \rightarrow \text{Ph}_3\text{P} \rightarrow \text{CH}_2 \\
\text{benzaldehyde} + \text{Ph}_3\text{P}=\text{CH}_2 & \rightarrow \text{Ph}_3\text{P} \rightarrow \text{CH}_2
\end{align*}
\]

The reaction is carried out under mild conditions, and the position of the carbon-carbon double bond is not in doubt. Carbonyl compounds may contain a wide variety of substituents, and so may the ylide. (Indeed, in its broadest form, the Wittig reaction involves reactants other than carbonyl compounds, and may lead to products other than substituted alkenes.)

The phosphorus ylides have hybrid structures, and it is the negative charge on carbon—the carbanion character of ylides—that is responsible for their characteristic reactions: in this case, nucleophilic attack on carbonyl carbon.

The preparation of ylides is a two-stage process, each stage of which belongs to a familiar reaction type: nucleophilic attack on an alkyl halide, and abstraction of a proton by a base.

Many different bases have been used—chiefly alkoxides and organometallics—and in a variety of solvents. For example,

\[
\begin{align*}
\text{Ph}_3\text{P + CH}_3\text{Br} & \rightarrow \text{Ph}_3\text{P} \rightarrow \text{CH}_2 \\
\text{Ph}_3\text{P + H}_2\text{C=CHCH}_2\text{Cl} & \rightarrow \text{Ph}_3\text{P} \rightarrow \text{CH}_2
\end{align*}
\]

In 1979, the Nobel Prize was awarded to Georg Wittig and to H. C. Brown, in recognition of their remarkable contributions to synthetic organic chemistry: Brown's centering about the element boron and Wittig's about phosphorus.