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Ring-Closing Metathesis Approach toward Phosphonosugars

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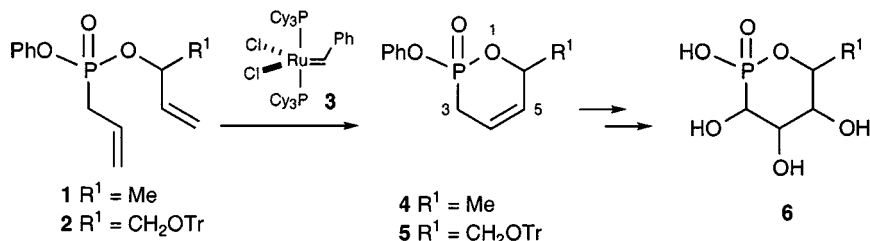
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RING-CLOSING METATHESIS APPROACH TOWARD PHOSPHONOSUGARS

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The ring closing metathesis (RCM) reaction continues to emerge as a powerful approach for the construction of complex organic molecules.^{1–3} Recently we have shown that the RCM reaction catalyzed by the Grubbs ruthenium catalyst is an effective method for the construction of phosphonate *P*-heterocycles.⁴ As a part of our program aimed at developing organometallic approaches to diverse phosphorus containing compounds, we herein report our efforts toward synthesis of cyclic phosphonate (phostones) analogs of carbohydrates containing phosphorus atom at the anomeric position. This class of compounds has received continued attention in the literature.⁵ Previous routes to phostone sugar analogs have employed the Abramov reaction of sugar aldehydes and di- or trialkyl phosphites, followed by intramolecular transesterification of the resulting hydroxyphosphonates. Our strategy utilizes the RCM reaction for the formation of the six-membered cyclic allylic phosphonates **4**, **5**. Epoxidation or dihydroxylation of these compounds followed by opening of the epoxide or cyclic carbonate results in the formation of a vinylphosphonates containing a hydroxy group at



SCHEME 1

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C(5). Subsequent dihydroxylation of the vinylphosphonates can be used to introduce hydroxy groups at the C(3) and C(4) positions. Our route is amenable to variations at several positions and should prove valuable in the diastereoselective synthesis of an array of highly functionalized cyclic phosphonates.

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