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NEW HOT PAPERS - 2009

November 2009

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Ulrich S. Schubert talks with *ScienceWatch.com* and answers a few questions about this month's New Hot Paper in the field of Chemistry.

Article Title: Clicking polymers: a straightforward approach to novel macromolecular architectures
Authors: Fournier, D;Hoogenboom, R;Schubert, US
Journal: CHEM SOC REV
Volume: 36
Issue: 8
Page: 1369-1380
Year: 2007
* Eindhoven Univ Technol, Dutch Polymer Inst, Lab Macromol Chem & Nanosci, POB 513, NL-5600 MB Eindhoven, Netherlands.
* Eindhoven Univ Technol, Dutch Polymer Inst, Lab Macromol Chem & Nanosci, NL-5600 MB Eindhoven, Netherlands.

SW: Why do you think your paper is highly cited?

The efficient functionalization and coupling of macromolecular building blocks has remained a major challenge for several decades. The introduction of "click chemistry" methods—a chemical philosophy introduced by K. Barry Sharpless of The Scripps Research Institute in 2001, which describes chemistry tailored to generate substances quickly and reliably by joining small units together—seems to have solved this challenge by allowing efficient functionalization under mild conditions with readily available reagents.

Therefore, the combination of click chemistry and macromolecules was widely accepted within the polymer society within only a few years. This critical review article summarizes recent efforts of click chemistry to functionalize macromolecules and to engineer new macromolecular articles. As such, the article serves as a source of inspiration as well as a database for people working in the field.

"...the use of click chemistry in macromolecular science has flourished over the past several years."

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

The article summarizes and critically discusses the use of click chemistry in macromolecular science, which has found widespread adaptation within just a few years.

SW: Would you summarize the significance of your paper in layman's terms?

Doing chemistry with large macromolecular building blocks provides a major challenge in purification if the transformation does not go to completion. In fact, separating two macromolecules with, e.g., different end-groups, is very difficult. Therefore, a very efficient reaction procedure is required to circumvent the

purification problem.

Click chemistry in general and the copper(I) catalyzed azide-alkyne cycloaddition in particular represents a highly efficient coupling procedure that was introduced by Sharpless, the 2001 Nobel Prize Laureate in Chemistry, with a stringent sets of requirements including high yields, mild conditions, readily available starting materials, and easy purification. These requirements perfectly fit the longstanding challenge of performing efficient chemical transformations on macromolecules. Therefore, the use of click chemistry in macromolecular science has flourished over the past several years. Click chemistry not only allowed efficient functionalization of macromolecular structures, but also enabled coupling of polymeric building blocks, leading to new macromolecular architectures that were not easily accessible without click chemistry, such as cyclic polymer structures.

SW: How did you become involved in this research, and were there any problems along the way?

In 2006, we were interested in the preparation of star-shaped poly(caprolactone) in an efficient way. After several attempts, we found that the use of click chemistry, in combination with microwave irradiation, yielded the star-shaped polymer in a high yield in only 15 minutes (Benz A, Hartig JS, "Redesigned tetrads with altered hydrogen bonding patterns enable programming of quadruplex topologies," *Chem Commun* 34:4010-12, Sep 14, 2008). At that time, this was the first report of using click chemistry to make star-shaped polymers, and after that many more reports appeared in the literature.

SW: Where do you see your research leading in the future?

In current research, many studies demonstrate that click chemistry can be used to prepare functionalized macromolecules and new macromolecular architectures. However, many of these reports focus on the synthetic aspect only. The focus of research combining macromolecules and click chemistry will change from demonstrating the advantages and feasibility towards using click chemistry to prepare and apply novel functional macromolecular architectures that were previously not accessible.

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Keywords: macromolecular building blocks, click chemistry, k. barry sharpless, macromolecules, performing efficient chemical transformations on macromolecules, functionalized macromolecules, star-shaped poly(caprolactone), star-shaped polymer, microwave irradiation.

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