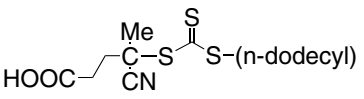
RAFT Agent Kit

(Reversible Addition-Fragmentation chain Transfer)

for controlling polymerizations at the molecular level

METALS • INORGANICS • ORGANOMETALLICS • CATALYSTS • LIGANDS • NANOMATERIALS • CUSTOM SYNTHESIS • cGMP FACILITIES

Strem offers the following RAFT agents for research purposes only under license from CSIRO.



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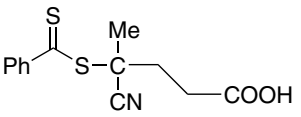

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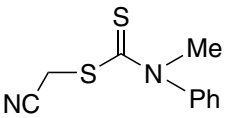

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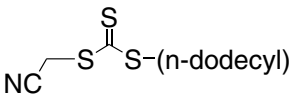

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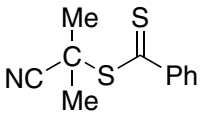

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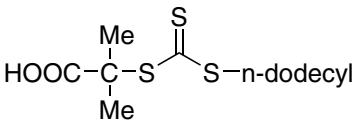

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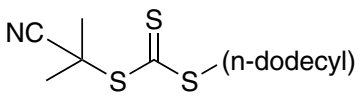
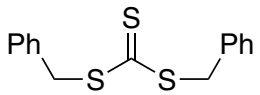


16-0610 500mg

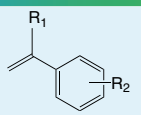
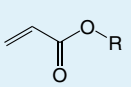
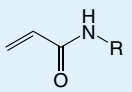
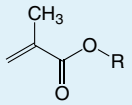
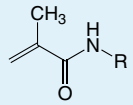
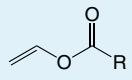
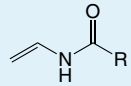


16-0617 500mg

96-4700 RAFT Agent Kit for controlling polymerizations at the molecular level

Contains the smallest unit size of each of the eight compounds below. Components areavailable for individual sale. RAFT Agents may be matched to monomers from the table.

RAFT Agent - Monomer Matching

Strem Catalog #	 styrenes	 acrylates	 acrylamides	 methacrylates	 methacrylamides	 vinyl esters	 vinyl amides
16-0423	--	--	--	--	--	+++	+++
16-0425	+++	+++	+++	--	--	--	--
16-0430	++	+	--	+++	+++	--	--
16-0422	++	+	+	+++	+++	--	--
16-0610	+++	++	++	+++	+++	--	--
16-0415	+++	++	++	+++	+++	--	--
16-0460	+++	++	++	+	+	--	--
16-0617	++	++	++	--	--	--	--

+ indicates compatibility (+ = compatible, ++ = more compatible, +++ = most compatible); -- indicates no data available

Catalog #	Description	Available Unit Sizes
16-0415	4-Cyano-4-(dodecylsulfanylthiocarbonyl)sulfanylpentanoic acid, min. 97% *(870196-80-8)*	500mg, 2g, 10g
16-0422	4-Cyano-4-(thiobenzoylthio)pentanoic acid, min. 97% *(201611-92-9)*	500mg, 2g, 10g
16-0423	2-Cyanomethyl-N-methyl-N-phenyldithiocarbamate, min. 97% *(76926-16-4)*	500mg, 2g, 10g
16-0425	2-Cyanomethyl-S-dodecyltrithiocarbonate, min. 97% *(796045-97-1)*	500mg, 2g, 10g
16-0430	2-Cyanoprop-2-yl-dithiobenzoate, min. 97% *(201611-85-0)*	500mg, 2g, 10g
16-0460	2-Methyl-2-[(dodecylsulfanylthiocarbonyl) sulfanyl]propanoic acid, min. 97% *(461642-78-4)*	500mg, 2g, 10g
16-0610	2-(2-Cyanoprop-2-yl)-S-dodecyltrithiocarbonate, min. 97% *(870196-83-1)*	500mg, 2g, 10g
16-0617	S,S-Dibenzyltrithiocarbonate, min. 97% *(26504-29-0)*	500mg, 2g, 10g

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RAFT technology

CSIRO and DuPont have developed an innovative technology known as RAFT (for Reversible Addition-Fragmentation chain Transfer), which allows for the synthesis of specially designed polymeric materials with enhanced properties. CSIRO has licensed this technology to Strem to make available to you for research purposes.

RAFT technology is a sophisticated form of controlled free radical polymerization. Often known as 'living polymerization' (it can be stopped and restarted at anytime) this technology enables the synthesis of tailored polymers with unprecedented control over composition and architecture.

Polymers may be synthesized more readily, using RAFT technology,

- With predetermined molecular weight and narrow molecular weight distributions over a wide range of monomers and reaction conditions,
- With reactive terminal groups that can be purposely manipulated, including further polymerization,
- With complex architecture, including A B diblock, A B A triblock, graft, star; gradient and branched polymers (*see Figure 1*),
- That are based on scaleable manufacturing processes utilizing conventional processing equipment.

RAFT technology can be used with a wide range of monomers and monomer mixtures, and can be used in all modes of free radical polymerization, including solution, emulsion and suspension polymerizations. This allows for an unlimited array of tailored compositions and complex architectures under standard conditions.

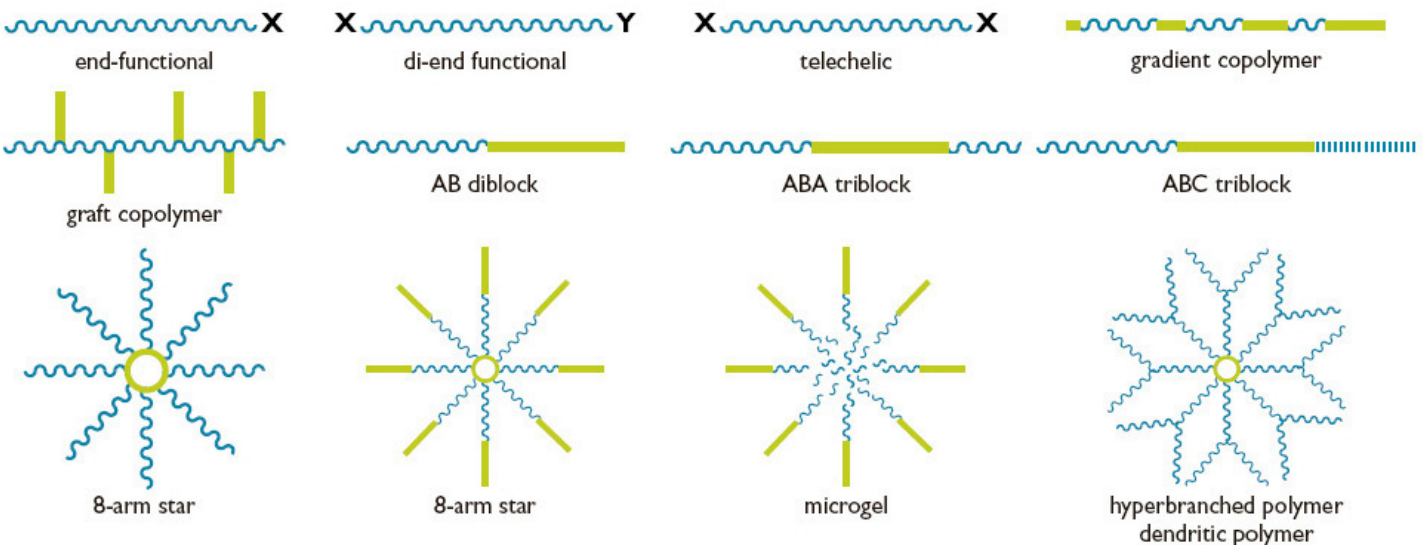

Figure 1: Polymer architectures possible with RAFT technology

The RAFT process

Implementing the RAFT process can be as simple as introducing a suitable chain transfer agent, known as a RAFT Agent (*see Figure 2*), into conventional free radical polymerization, while employing conventional plant and equipment. The RAFT Agents allow for the preparation of polymers with low polydispersity, well-defined microstructure and predetermined molecular weight.

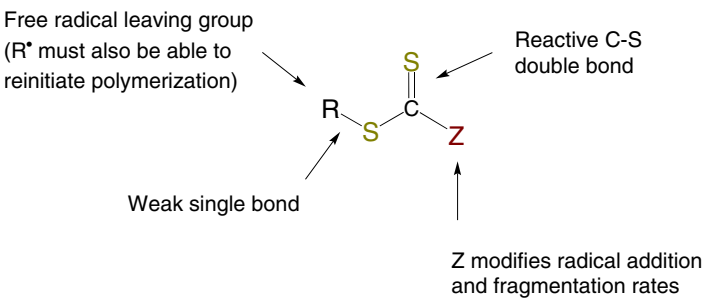

Figure 2: The essential feautures of the RAFT Agent

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As the newly formed polymer is terminated by an active RAFT group, thereby rendering it a RAFT Agent in its own right, it is capable of undergoing further polymerization reactions or can be subjected to other chemical manipulations (*see Figure 3*). Incorporation of the RAFT Agent in the final polymer obviates the need for its removal, thereby simplifying the isolation and purification of the final polymer product. The RAFT process is a user and, environmentally friendly process that does not require expensive and contaminating additives unlike other controlled free radical polymerization processes (eg. ATRP).

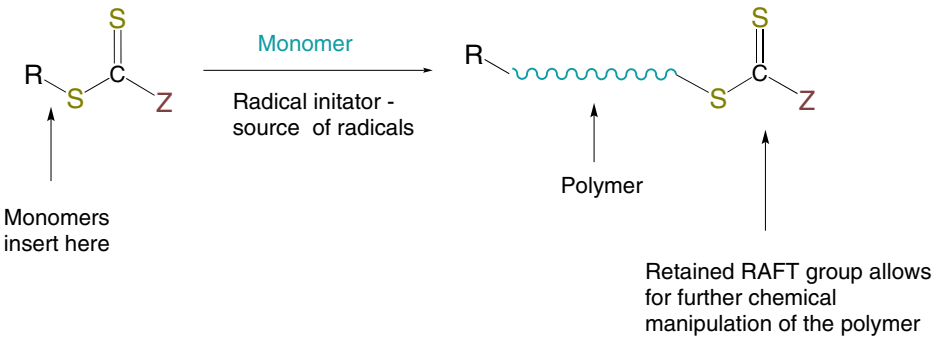

Figure 3: At the heart of it - The process of RAFT polymerization

The RAFT process is typically started by a separate, commercially available, free radical initiator. The RAFT Agent is rapidly incorporated into the growing polymer and facilitates further growth of the polymer by incorporating monomer, one unit at a time. Incorporation of the RAFT Agent into the final polymer results in a cleaner and more versatile product.

Overall, RAFT polymerization results in:

- polymers with controlled molecular weight
- narrow distribution of molecular weight, i.e. low polydispersity
- ability to incorporate, in a defined sequence, one or more type of monomers in the polymer chain
- RAFT group retained in the final polymer
- opportunity for further chemical manipulation of the RAFT group, including further polymerization or removal

Further detailed information on RAFT technology may be found in the following references:

- Living Free-Radical Polymerization by Reversible Addition-Fragmentation Chain Transfer:The RAFT Process, J. Chiefari, et al, *Macromolecules*, **1998**,*31*,5559-5562.
- Living Radical Polymerization by the RAFT Process. G. Moad, E. Rizzardo, S. H.Thang, *Aust. J. Chem*. **2005**,*58*, 379-410.
- Living Radical Polymerization by the RAFT Process -A First Update, G. Moad, E. Rizzardo, S. H.Thang, *Aust. J. Chem*. **2006**,*59*, 669-692.
- Radical addition-fragmentation chemistry in polymer synthesis, G. Moad, E. Rizzardo, S H. Thang, *Polymer* 49 (**2008**), 1079-1131.

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