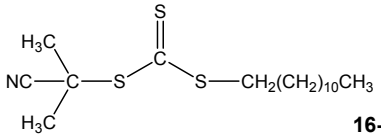
RAFT Agent Kit

(Reversible Addition-Fragmentation chain Transfer)

for controlling polymerizations at the molecular level

metals · inorganics · organometallics · catalysts · ligands · custom synthesis · cGMP facilities · nanomaterials

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



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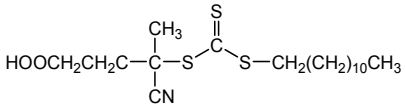

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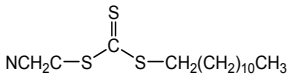

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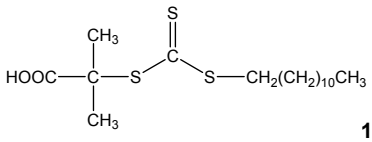

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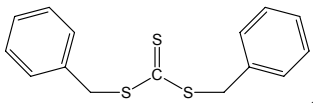

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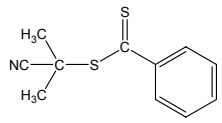

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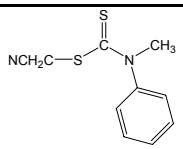

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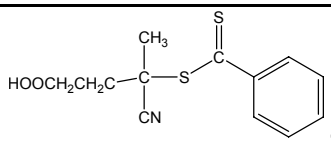
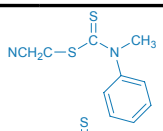
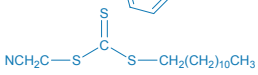
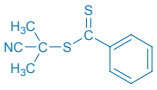
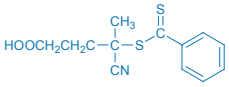
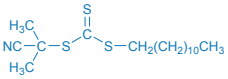
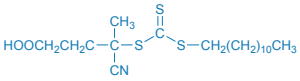
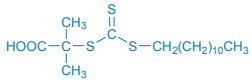
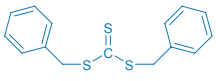


16-0422

RAFT Agent – Monomer Matching

96-4700 **RAFT Agent Kit** for controlling polymerizations at the molecular level.
Contains the smallest unit size of the eight compounds listed. Components available for individual sale.
RAFT Agents may be matched to monomers from the table.

Strem Cat. #	Kit # 96-4700 contains smallest size each of the following components	styrenes	acrylates	acrylamides	methacrylates	methacrylamides	vinyl esters	vinyl amides
16-0423 500mg; 2g; 10g		—	—	—	—	—	+++	+++
16-0425 500mg; 2g; 10g		+++	+++	+++	—	—	—	—
16-0430 500mg; 2g; 10g		++	+	—	+++	+++	—	—
16-0422 500mg; 2g; 10g		++	+	+	+++	+++	—	—
16-0610 500mg; 2g; 10g		+++	++	++	+++	+++	—	—
16-0415 500mg; 2g; 10g		+++	++	++	+++	+++	—	—
16-0460 500mg; 2g; 10g		+++	++	++	+	+	—	—
16-0617 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.

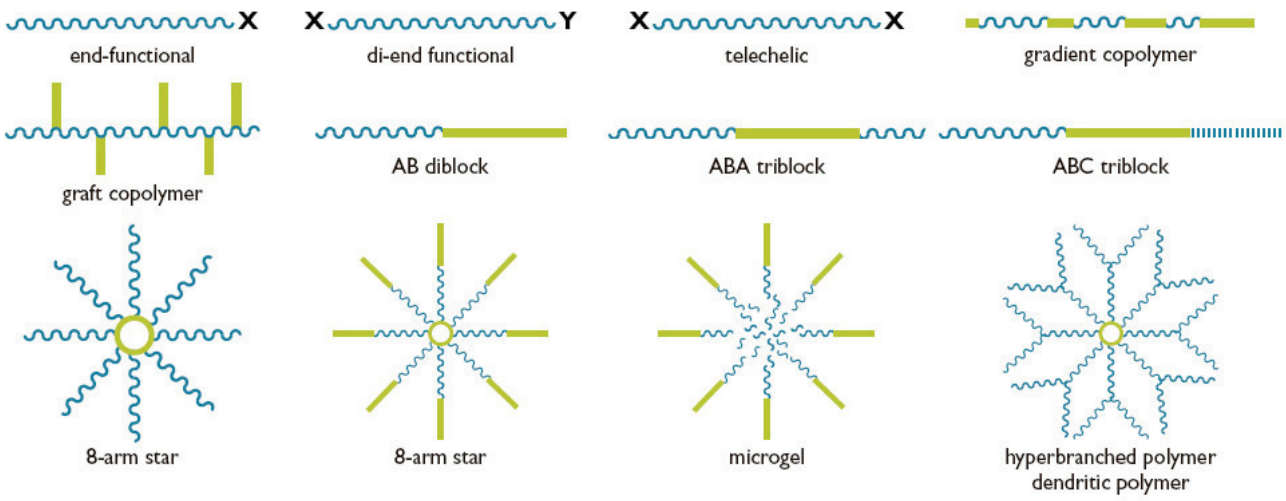
RAFT technology is a sophisticated form of controlled free radical polymerization. Often known as 'living polymerization' (it can be stopped and restarted at anytime) this technology enables the synthesis of tailored polymers with unprecedented control over composition and architecture.

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 Fig I),
- 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.

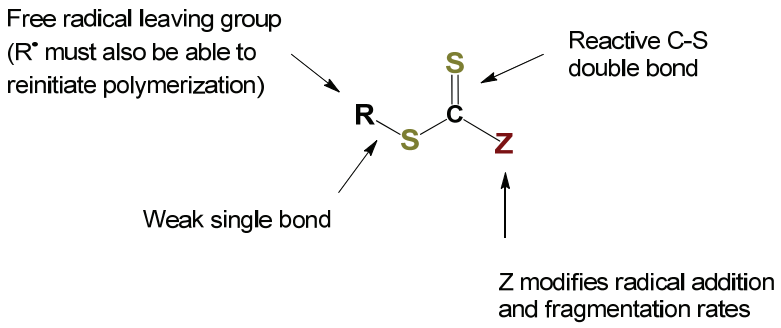
Fig I: Polymer architectures possible with RAFT technology



The RAFT process

Implementing the RAFT process can be as simple as introducing a suitable chain transfer agent, known as a RAFT Agent (see Fig 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.

Fig 2: The essential features of the RAFT Agent



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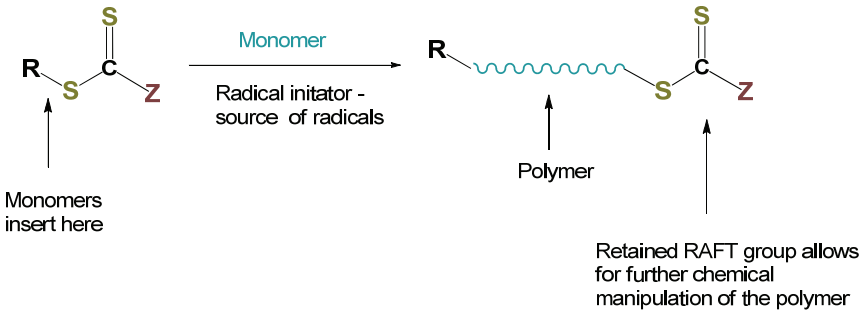
As the newly formed polymer is terminated by an active RAFT group, thereby rendering it a RAFT Agent in its own right, it is capable of undergoing further polymerization reactions or can be subjected to other chemical manipulations (see Fig 3). Incorporation of the RAFT Agent in the final polymer obviates 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).

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.

> **Fig 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
- The ability to incorporate, in a defined sequence, one or more type of monomers in the polymer chain
- The RAFT group being retained in the final polymer, and
- The opportunity for further chemical manipulation of the RAFT group, including further polymerization or removal

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NEW *RAFT Agents*

(Reversible Addition-Fragmentation chain Transfer)

for controlling polymerizations at the molecular level

metals · inorganics · organometallics · catalysts · ligands · custom synthesis · cGMP facilities · nanomaterials

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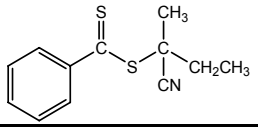
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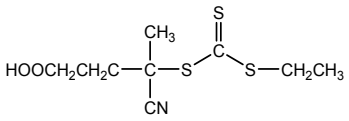
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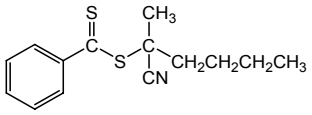
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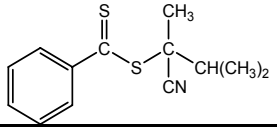
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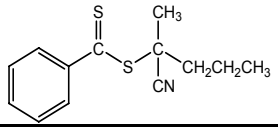
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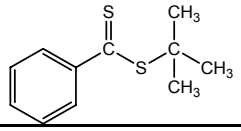
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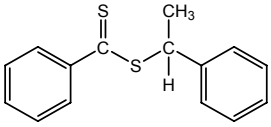
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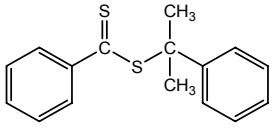
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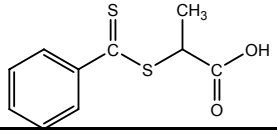
16-0532

LIMITED QUANTITIES

The following products are available in limited quantities and may be discontinued when stock is gone.

16-0517 NEW→	**2-Cyano-2-butylbenzodithiolate** *[220182-83-2]* $C_{12}H_{13}NS_2$; FW: 235.37; dark red liq. *light sensitive, (store cold)*	100mg
16-0417 NEW→	**4-Cyano-4-[(ethylsulfanylthiocarbonyl)sulfanyl]pentanoic acid, min. 97%** *[1137725-46-2]* $C_9H_{13}NO_2S_3$; FW: 263.40; yellow-orange pwdr. *light sensitive, (store cold)*	250mg 1g
16-0516 NEW→	**2-Cyano-2-hexylbenzodithiolate** $C_{14}H_{17}NS_2$; FW: 263.42; dark red liq. *light sensitive, (store cold)*	100mg
16-0528 NEW→	**2-Cyano-3-methyl-2-butylbenzodithiolate** $C_{13}H_{15}NS_2$; FW: 249.40; dark red liq. *light sensitive, (store cold)*	100mg
16-0523 NEW→	**2-Cyano-2-pentylbenzodithiolate** $C_{13}H_{15}NS_2$; FW: 249.40; dark red liq. *light sensitive, (store cold)*	100mg
16-0521 NEW→	**2-Methyl-2-propylbenzodithiolate** *[5925-55-3]* $C_{11}H_{14}S_2$; FW: 210.36; red-orange liq. *light sensitive, (store cold)*	100mg
16-0526 NEW→	**2-Phenylethylbenzodithiolate** *[37912-25-7]* $C_{15}H_{14}S_2$; FW: 258.40; red-orange liq. *light sensitive, (store cold)*	100mg
16-0513 NEW→	**2-Phenyl-2-propylbenzodithiolate, min. 97%** *[201611-77-0]* $C_{16}H_{16}S_2$; FW: 272.43; dark red-purple liq. *light sensitive, (store cold)*	250mg
16-0532 NEW→	**2-(Thiobenzoylthio)propionic acid, min. 97%** *[78751-36-7]* $C_{10}H_{10}O_2S_2$; FW: 226.32 *light sensitive, (store cold)*	100mg 500mg

Note: Sold for research purposes only. Not for use in humans or animals. Patents: WO98/01478, WO99/311444.

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