Dissemination of IT for the Promotion of Materials Science (DoITPoMS)

- What is it?
- How did it come about?
- How can it be used?
- What have we learnt?

UNIVERSITY OF CAMBRIDGE

Department of Materials Science & Metallurgy

- Supported by the Fund for the Development of Teaching and Learning (FDTL).

5 Partner Institutions:

- University of Leeds, Department of Materials
- University of Manchester / UMIST, Manchester Materials Science Centre
- London Metropolitan University (formerly University of North London), School of Polymer Technology
- Oxford Brookes University, School of Engineering
- University of Sheffield, Department of Engineering Materials

- Close links with the UK Centre for Materials Education and with the MATTER project, both based at the University of Liverpool.

search contact

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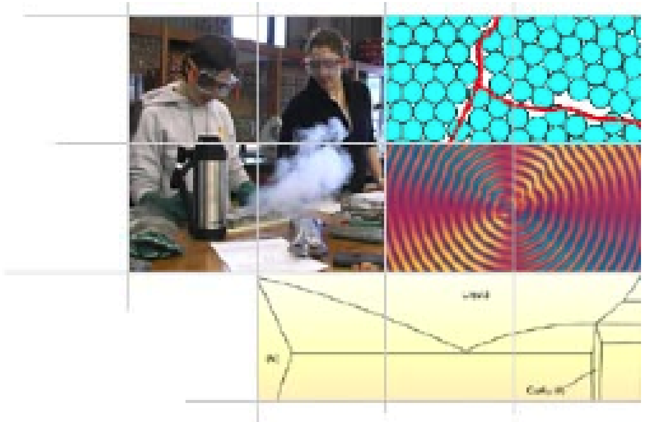

About DoITPoMS
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Contact Us

Micrograph Library
Teaching and Learning Packages

Community (login required)

DoITPoMS, Department of Materials Science and Metallurgy, University of Cambridge
Information provided by doitpoms@msm.cam.ac.uk.

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Dissemination of IT for the Promotion of Materials Science (DoITPoMS)

About DoITPoMS

Aims, objectives and resources

To build on recognised expertise in the use of information technology (IT) in enhancing the student learning experience and to disseminate these techniques within the Materials Education community in the UK.

Objectives

- To create a primary archive of photomicrographs, digital video clips, etc, for use by teachers in developing secondary resources, and as a teaching and learning resource in its own right.
- To create a library of exemplar teaching and learning packages (TLPs) covering common topics and making use of video clips and other material from the primary archive.

Resources

To date the following resources have been created and are undergoing continuing development:

- Micrograph Library
- Library of Teaching and Learning Packages

A library of video clips is currently under development.

Download an Infosheet (PDF, 255 KB)

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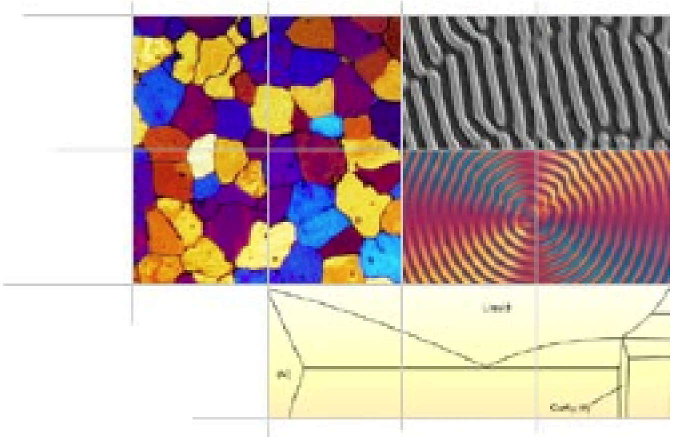
DoITPoMS Micrograph Library

DoITPoMS > Micrograph Library



Search the Library [ ] Go

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Techniques
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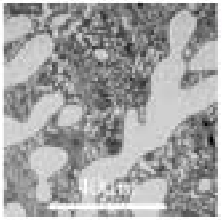
DoITPoMS Micrograph Library

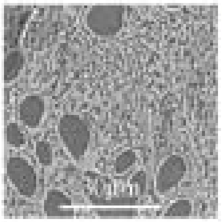
Search results

91 micrographs found, ordered by micrograph number.

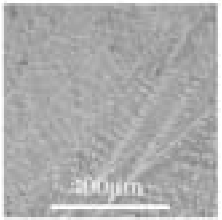
Showing **1 - 10** of **91** micrographs Page **1** 2 3 4 5 6 7 .. 10 | Previous | Next



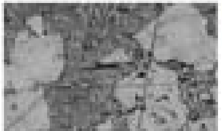
Micrograph 1 : Al 75, Cu 25 (wt%), hypoeutectic alloy
System: Al-Cu, Composition: Al 75, Cu 25 (wt%)
Reflected light microscope
40 µm



Micrograph 2 : Al 75, Cu 25 (wt%), hypoeutectic alloy
System: Al-Cu, Composition: Al 75, Cu 25 (wt%)
Scanning electron microscope (SEM)
30 µm



Micrograph 5 : Al 64, Cu 36 (wt%), hypereutectic alloy
System: Al-Cu, Composition: Al 64, Cu 36 (wt%)
Reflected light microscope
400 µm



Micrograph 8 : Bi 80, Cd 20 (wt%), hypereutectic alloy
System: Bi-Cd, Composition: Bi 80, Cd 20 (wt%)
Reflected light microscope
400 µm

Full Record for Micrograph 10

[110 KB]

View micrograph
.. in new window

View micrograph and record
.. in new window

Micrograph no
10

Brief description
Cu 70, Ni 30 (wt%), cored dendrites

Keywords
alloy m, copper, coring m, dendrite m, metal, nickel, partition coefficient m

Categories
Metal or alloy

System
Cu-Ni

Composition
Cu 70, Ni 30 (wt%)

Standard codes

Reaction

Processing
Chill cast

Applications

Sample preparation
Etched in NH4OH/H2O2

Technique
Reflected light microscope

Length bar
400 μm

Further information
This alloy is typical of many copper based alloy systems. The dendrite structure shows coring (variation in solute concentration). The light areas are rich in nickel and the darker areas are low in

Reaction

Processing

Chill cast

Applications

Sample preparation

Etched in NH_4OH/H_2O_2

Technique

Reflected light microscope

Length bar

400 μm

Further information

This alloy is typical of many copper based alloy systems. The dendrite structure shows coring (variation in solute concentration). The light areas are rich in nickel and the darker areas are low in nickel. Chill casting extracts heat quickly enough to prevent significant solid state diffusion, resulting in cored dendrites. The centres of the dendrites that cool near the liquidus temperature, are nickel rich compared to the outer layers that solidify at progressively lower temperatures. Because the partition coefficient is positive the outer layers solidify with progressively lower nickel concentrations. The observed pattern results from the intersection of the plane of polish and the randomly orientated regions of equal solute concentration.

Contributor

Library of Teaching and Learning Packages for Materials Science

The following teaching and learning packages (TLPs) are largely based on first year materials science laboratory work in the Department of Materials Science and Metallurgy at the University of Cambridge, with the exception of "The Jominy End Quench Test". This is largely based on content developed at Manchester, with additional contributions from Oxford Brookes, Cambridge and MATTER.

Library of Teaching and Learning Packages for Materials Science

THE STIFFNESS OF RUBBER

This teaching and learning package is based on a two experiments which demonstrate the behaviour of rubber under tension. The first displays the unusual behaviour of a rubber strip when heated under tension; the second considers the behaviour of a rubber membrane under tension. In both cases the behaviour is considered theoretically in terms of the molecular structure of rubber and the thermodynamic entropy changes involved.

begin

THE STIFFNESS OF RUBBER

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Biaxial tension
Balloon experiment

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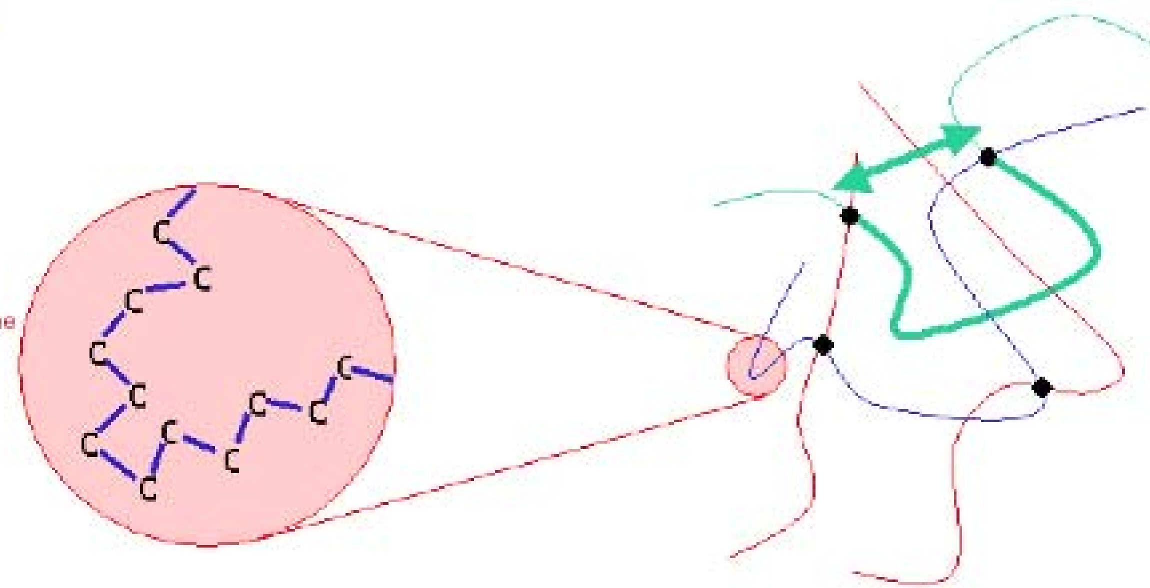
Theory of rubber conformation

Polymer Coils

Polymer molecules are made up of many smaller units called monomers. A rubber is a fully amorphous, lightly cross-linked polymer, above T_g. They are normally composed of a -C-C- backbone chain. The bond angle is fixed at 109.5°, but the torsion angle can change, allowing the macroscopic shape of the chain to vary from being linear to being highly coiled and convoluted.



In this diagram, on the left each blue line represents a C-C link. The arrow shows the end-to-end distance of the chain segment, depicted as a thickened line. The segments tend to coil up to some extent, rather than aligning in a straight line. This can be thought of as the

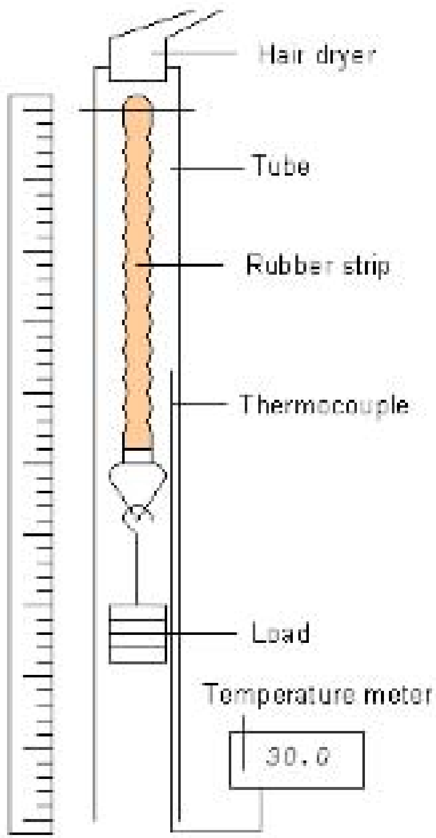
Contraction experiment

The theory predicts that the stiffness of rubber is proportional to the temperature.

$$\sigma = \frac{kTN}{V_0}\left(\lambda_3 - \frac{1}{\lambda_3^2}\right)$$

The result of this is that, if the rubber is extended under a fixed load, it is likely to contract when it is heated (even after allowance is made for the thermal expansion).

This can be observed using the following apparatus:



THE STIFFNESS OF RUBBER

Questions

Quick questions

You should be able to answer these questions without too much difficulty after studying this TLP. If not then you should go through it again!

1. Materials expand when heated because:

   a The mean interatomic distance increases as the thermal energy of the atoms increases

   b The heat takes up extra volume forcing the material to expand

   c The rubber melts

   d There are more chemical bonds being formed

   Answer

2. When rubber is put under uniaxial tension it:

   a Contracts

   b Extends

   c Explodes

   d Rises

   Answer

3. Rubber differs from all other materials in that:

THE STIFFNESS OF RUBBER

Going further

Websites

- Bouncing Balls
  "Everything you ever wanted to know about rubber (history, biographies, chemistry and conservation)", a site maintained by John Loadman.
- The Story of Rubber
  A "self-guided polymer expedition", including a Polymer Science Learning Center, based at the Department of Polymer Science in the University of Southern Mississippi.
- Thermodynamic Properties of Elastomers
  Written by Professor Kathryn R Williams at the University of Florida's Department of Chemistry.
- The Story of Natural Rubber
  A site maintained by the Tun Abdul Razak Research Centre, a unit of the Malaysian Rubber Board.

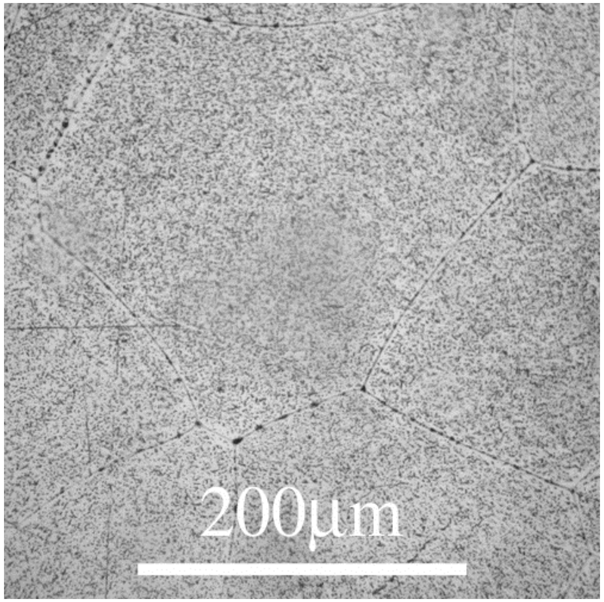
Use of Resources

- Lecturers / teachers:
  - learn from it
  - get ideas for practicals or demonstrations
  - use *instead* of practicals / demonstrations
  - use resources for lecture notes / visuals
  - set as homework
- Students:
  - support for courses (e.g. to access at home)
  - prepare for a lab. class
  - project work
  - revision / general broadening of knowledge

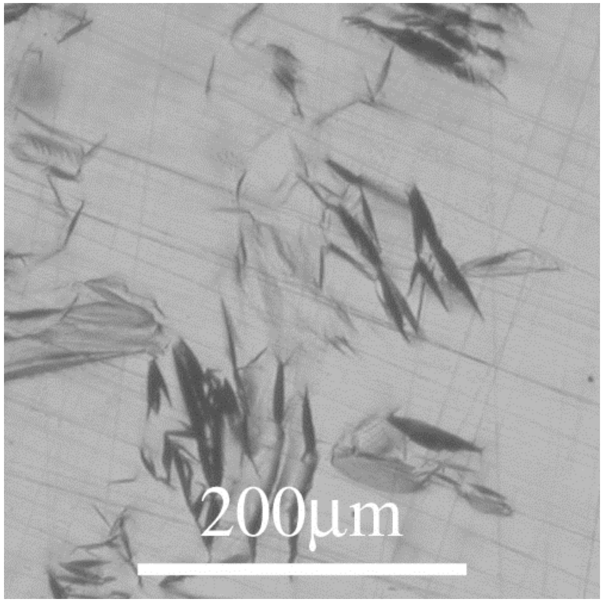
Micrographs as illustrations, for overheads, lecture hand-outs, question sheets, etc.

1.1. The drive to equilibrium.

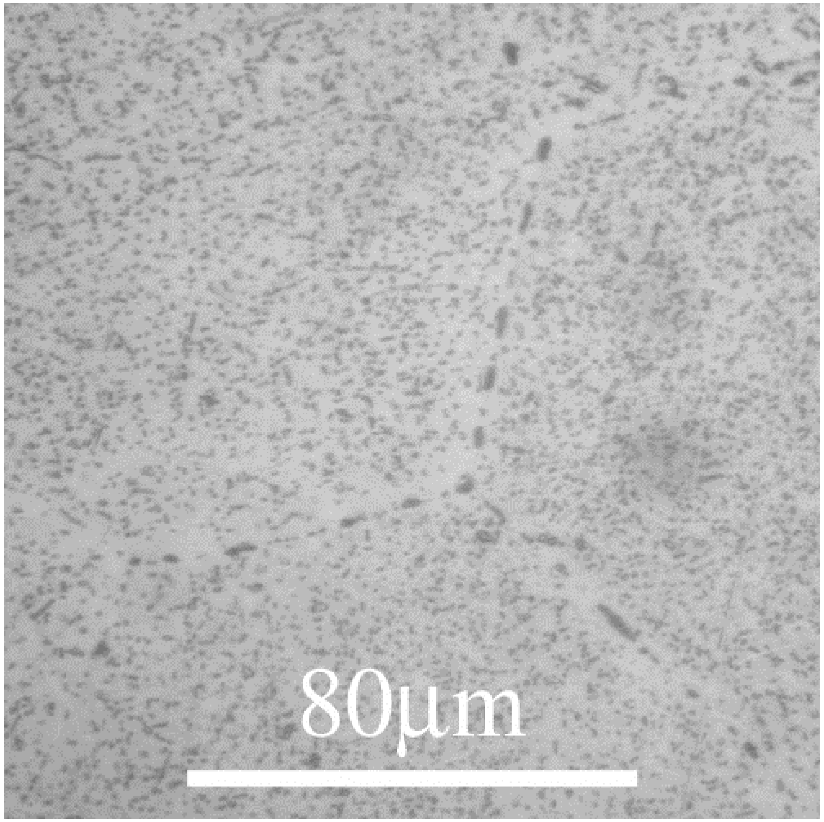
1.1.1 Quenching can lead to a supersaturated solid solution which will, on annealing, tend towards its equilibrium phase distribution; beginning with precipitation.



1.1.2 The metastable martensitic micro-structure, which may show a lenticular morphology (due to shearing during the transformation), will revert to ......



2.1. Preferential precipitation on grain boundaries



The θ precipitates preferentially form on Al grain boundaries, as these are excellent heterogeneous nucleation sites.

The depletion of Cu near the boundaries to these precipitates is one reason for the formation of adjacent **precipitation free zones (PFZ)**.

-from “Further information”

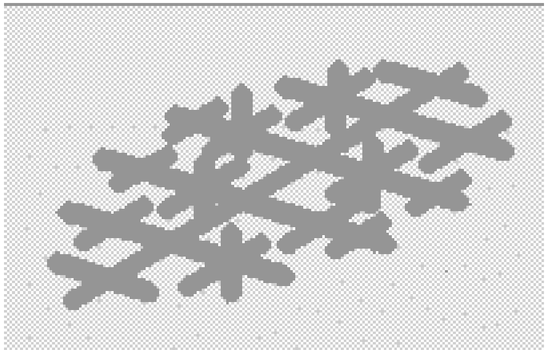
Grain boundaries act as sinks for solute and vacancies. This has the effect of increasing the precipitation on the grain boundary relative to the surrounding region, often leaving a precipitate free zone (PFZ) close to the boundary. This phenomenon is detrimental to the material since there is a reduction in precipitation hardening in the PFZ.

-from Glossary

...... the glossary for key words:

Dendrite

When metallic phases form during solidification, they often do so along certain preferred directions that relate to their crystal structure. The resultant tree-like structures are called dendrites.

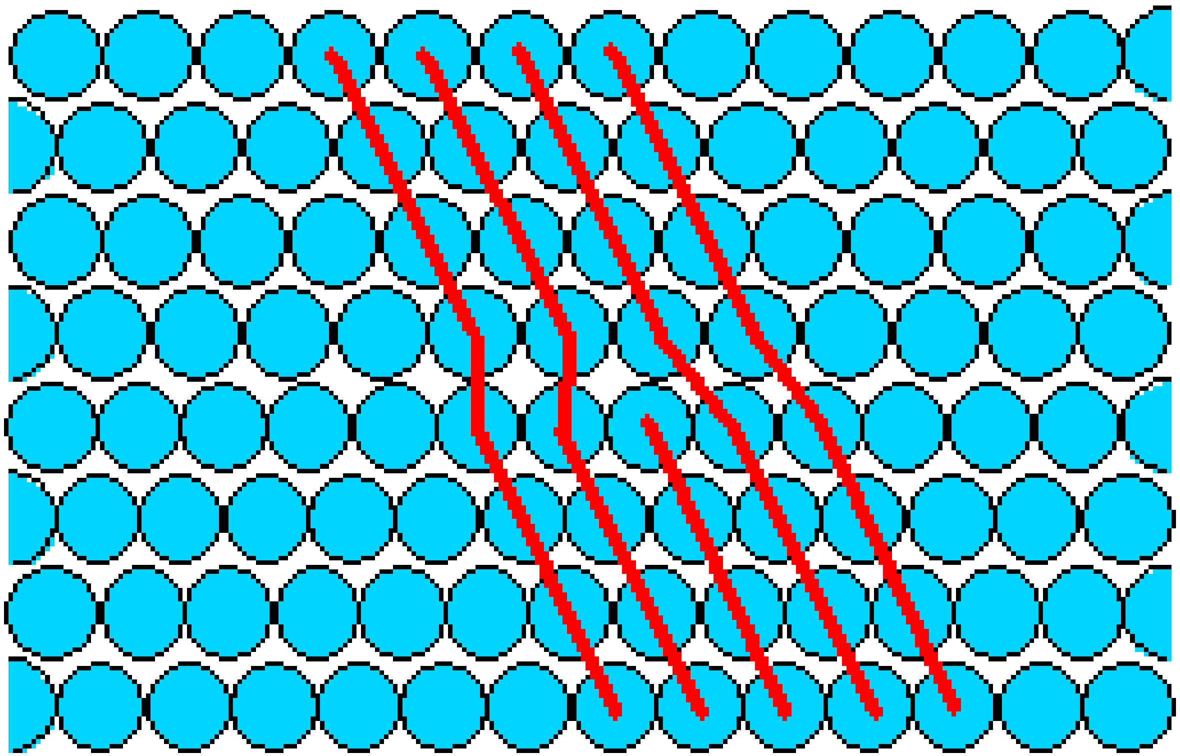


Related entries:
Crystal
Phase

Contributed by MATTER, The University of Liverpool

From the Teaching & Learning Packages:

A Dislocation in a 2D Close Packed Plane



QuickTime™ and a
Sorenson Video 3 decompressor
are needed to see this picture.

Use of Resources

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    - revision / general broadening of knowledge

What did we learn?

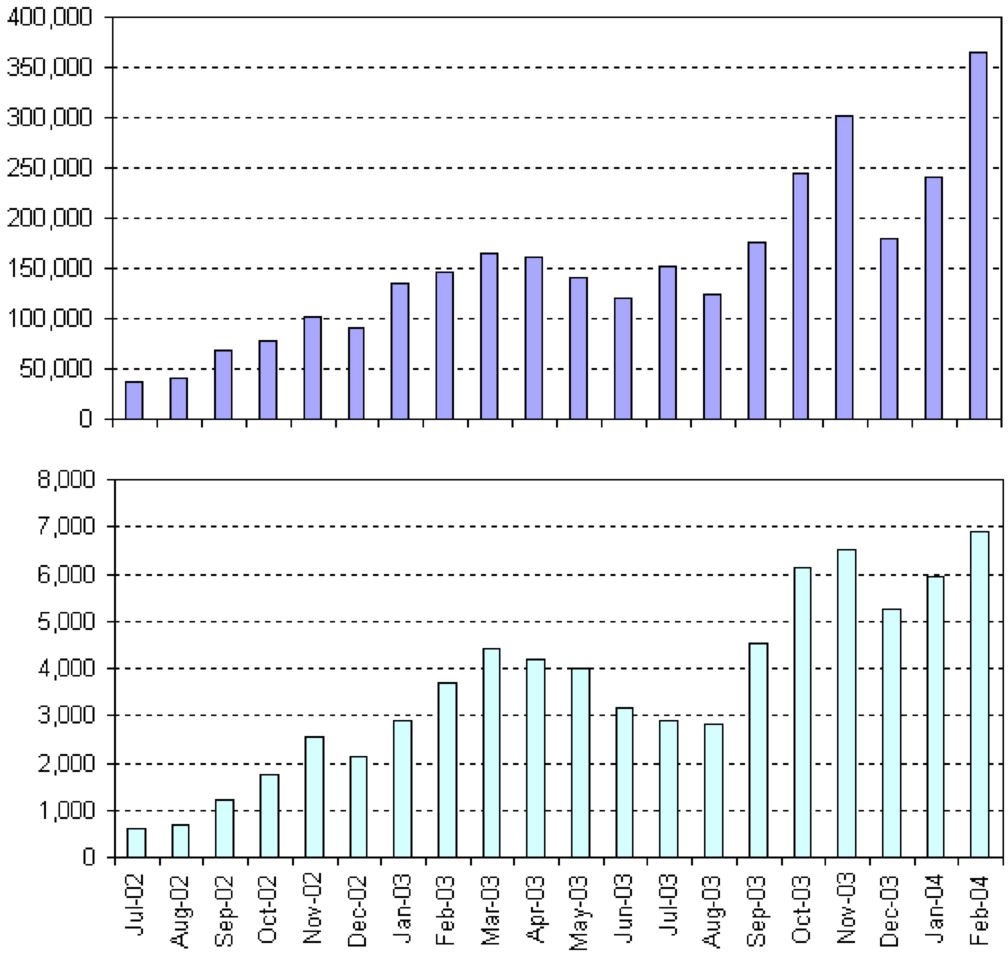
- Importance of format and style
- Critical mass for resource library
- More risky nature of TLPs
- Principal input from partner institutions was for trials and dissemination

Advantages of:

- Advertising course content
- On-line feedback

Get students involved!

- They enjoy it (empowerment!)
- They learn from it
- They get enthused about materials science
- They have great ideas (are often closer to the market)



Successful requests

Distinct hosts served