FISICA DEI MATERIALI POLIMERICI

- non solo chimica e ingegneria -

Giancarlo Locati


1,27 cm (P)
5,15 cm (L)
11 cm (A)
SAMSUNG


SAMSUNG

COLORI | COLORS

NERO 01 / NERO 01

ROSSO 09 / ROSSO 09

GRIGIO 02 / SILVER 25

materiale
Policarbonato NG
Polipropilene
(NG= New Generation light Pc blend of Bayer)

material
Polycarbonate NG
Polypropilen
(NG= New Generation light Pc blend of Bayer)

codice esempio 0225: 02 indica il colore del fascione in PP e degli accessori (serrature, maniglia traino, ruote), 25 indica il colore del guscio termoformato.

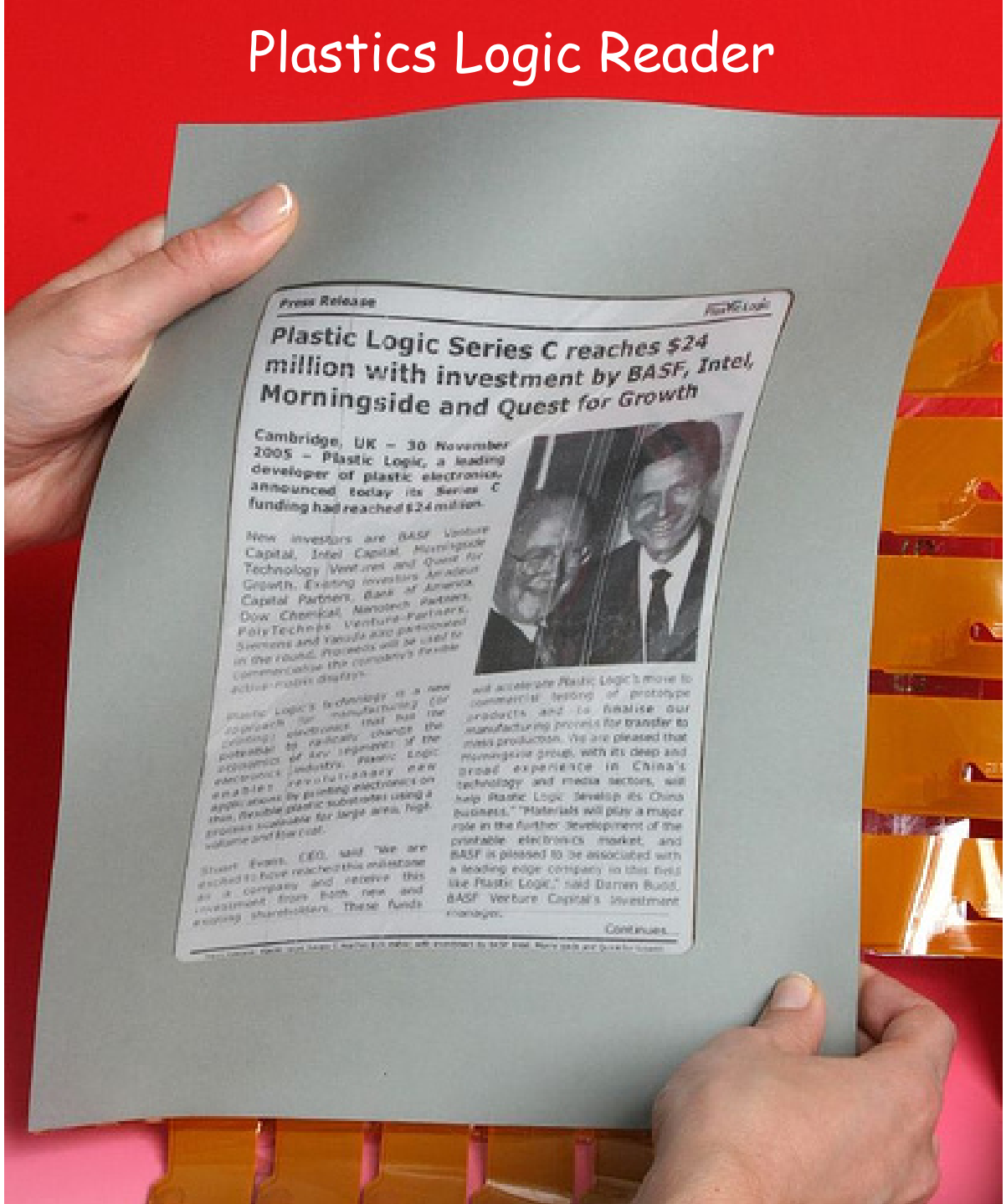
example code 0225: 02 suggests the colour of PP frame and accessories (locks, trolley handle, wheels), 25 indicate colour of thermoformed shell.

Made in Italy

RONCATO UNO SL | RONCATO UNO SL


udi A6

Plastics Logic Reader



Press Release

Plastic Logic Series C reaches $24 million with investment by BASF, Intel, Morningside and Quest for Growth

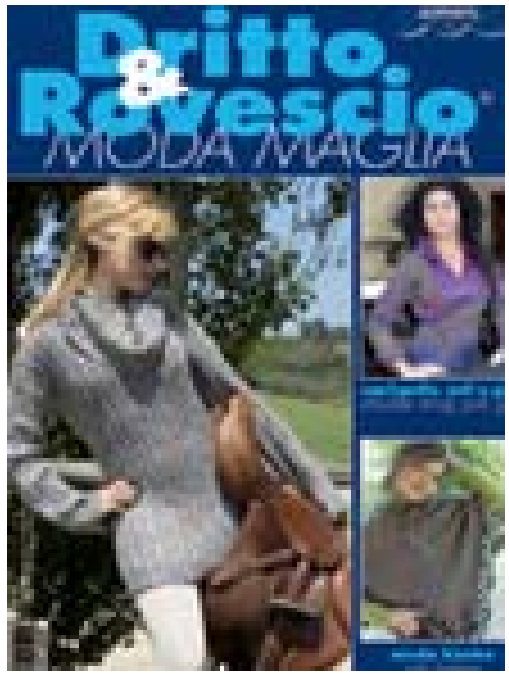
Cambridge, UK – 30 November 2005 – Plastic Logic, a leading developer of plastic electronics, announced today its Series C funding had reached $24 million.

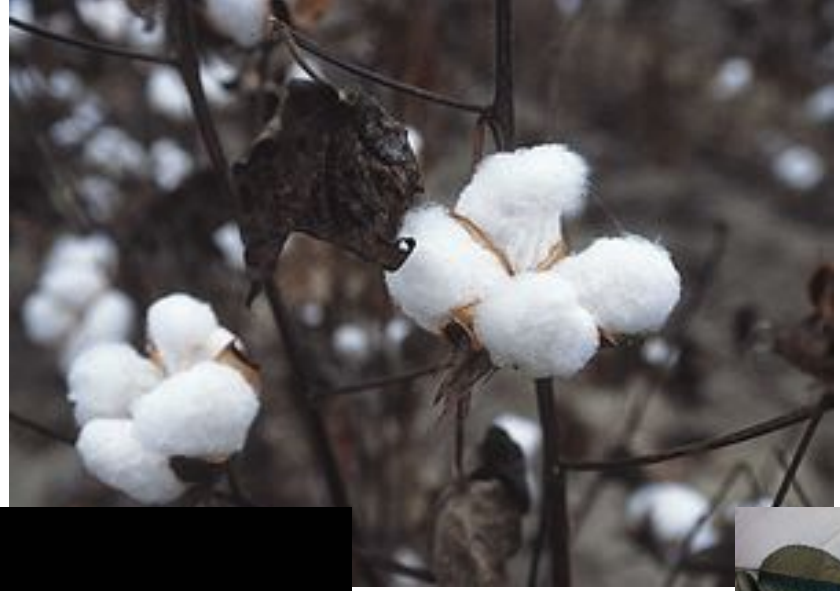
New investors are BASF Venture Capital, Intel Capital, Morningside Technology Ventures and Quest for Growth. Existing investors Amadeus Capital Partners, Bank of America, Dow Chemical, Nanotech Partners, PolyTechnos Venture-Partners, Siemens and Yasuda also participated in the round. Proceeds will be used to commercialise the company's flexible active-matrix display.

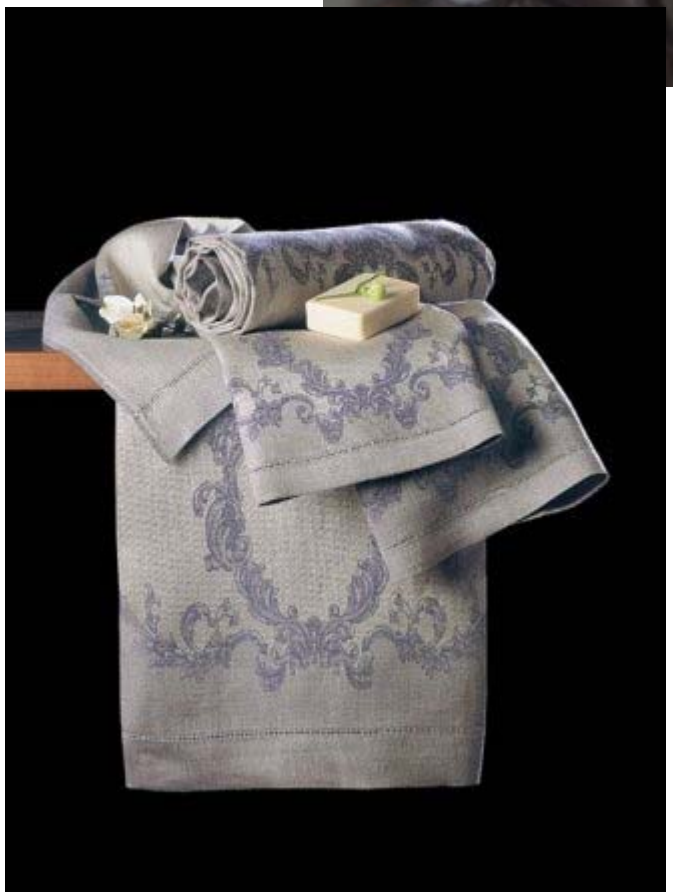
Plastic Logic's technology is a new approach for manufacturing (or printing) electronics that has the potential to radically change the economics of any segment of the electronics industry. Plastic Logic enables revolutionary new applications by printing electronics on thin, flexible plastic substrates using a process scaleable for large area, high volume and low cost.

Stuart Evans, CEO, said "We are excited to have reached this milestone as a company and receive this investment from both new and existing shareholders. These funds will accelerate Plastic Logic's move to commercial testing of prototype products and to finalise our manufacturing process for transfer to mass production. We are pleased that Morningside group, with its deep and broad experience in China's technology and media sectors, will help Plastic Logic develop its China business." "Materials will play a major role in the further development of the printable electronics market, and BASF is pleased to be associated with a leading edge company in this field like Plastic Logic," said Darren Rudd, BASF Venture Capital's investment manager.

Continues...

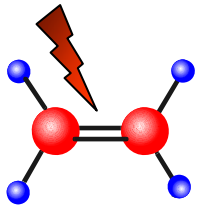

Dritto
Rovescio
MODA MAGLIA






lenzuola in lino
made in italy

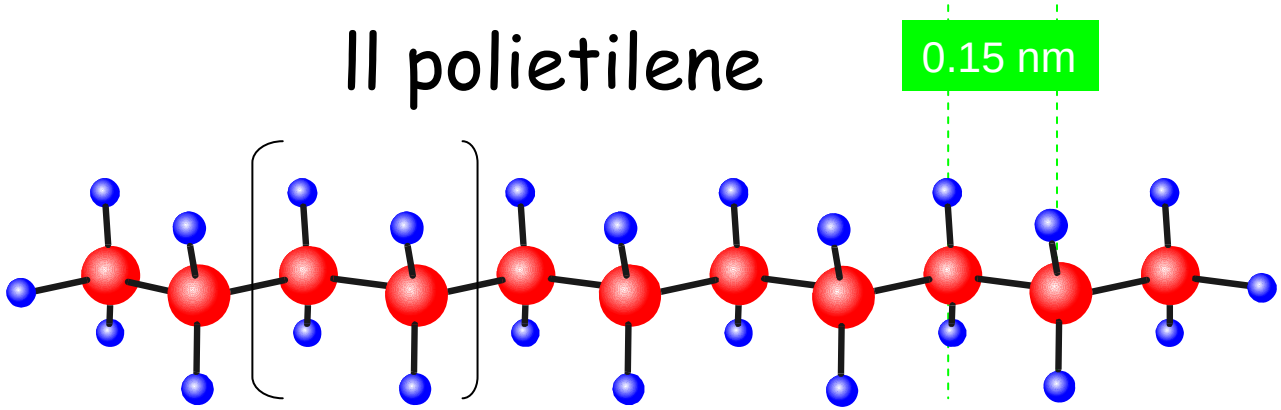
l'etilene

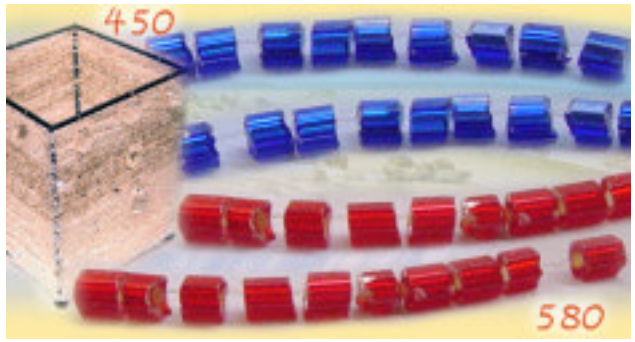


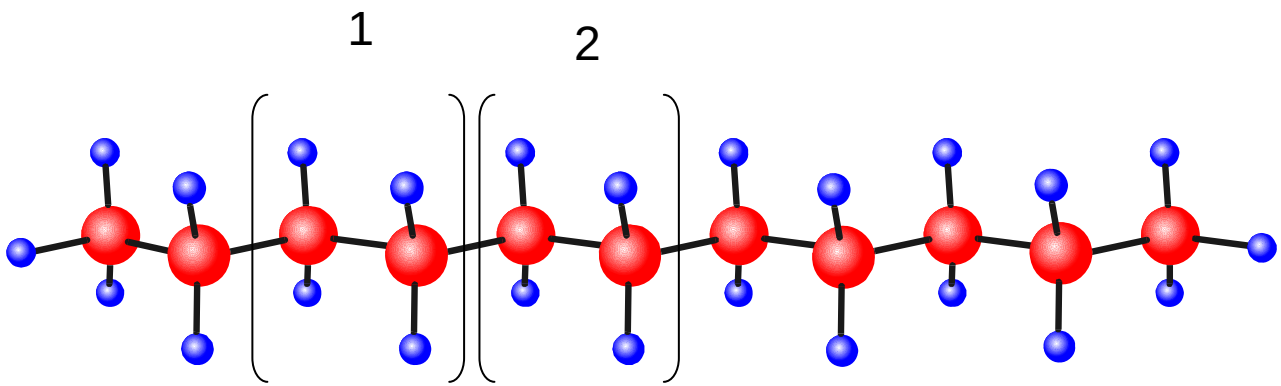
Carbonio

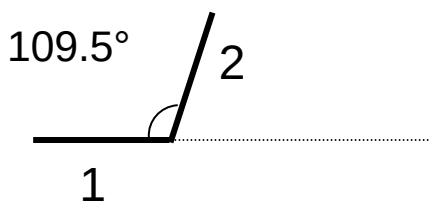
Idrogeno

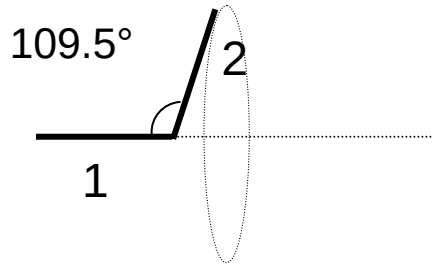
Il polietilene



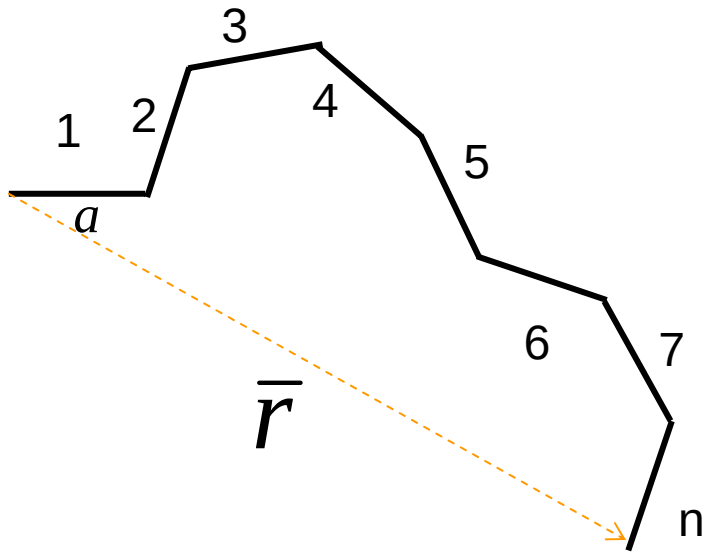



1
2


109.5°
2
1

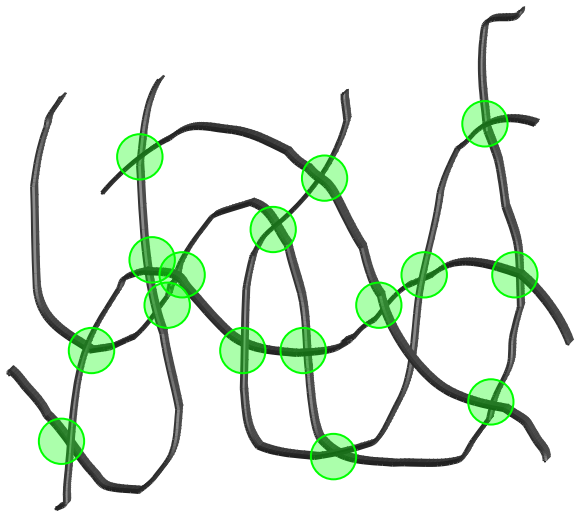

109.5°
2
1

Random coil ⇨ Random flights



$\bar{r}$ = distanza media testa-coda

$\frac{\bar{r}}{n\,a}$ è una misura della flessibilità della catena



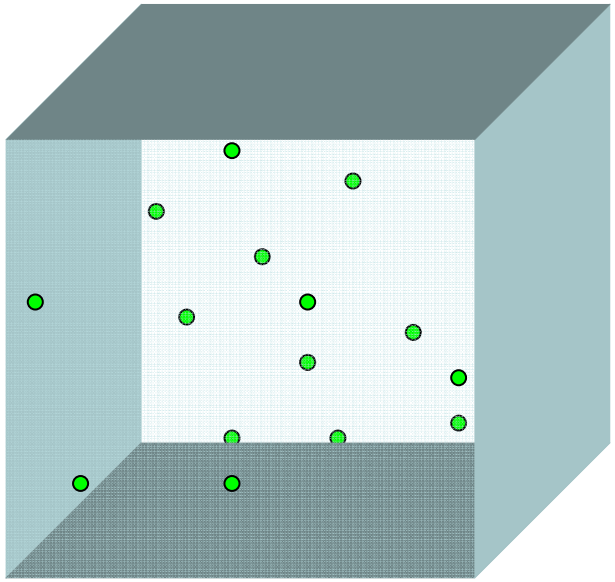
entanglements

un sistema molto disordinato

(stato amorfo)

n_e = *numero di entanglement/cm^3*

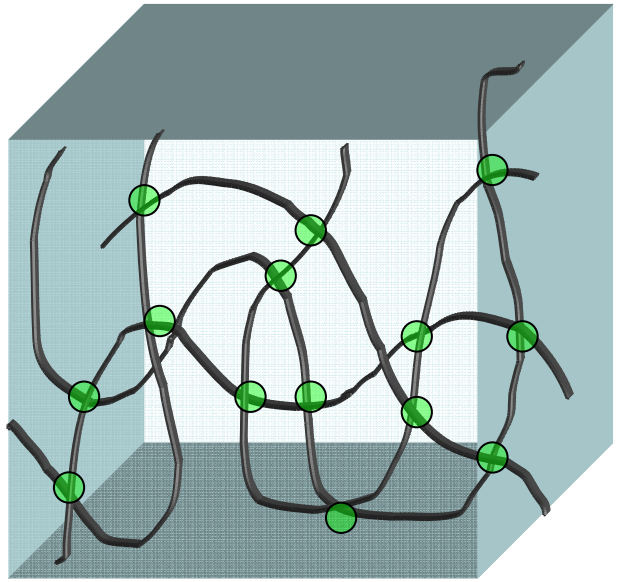
Teoria cinetica dei gas



$$pV = nRT$$

n = numero di moli

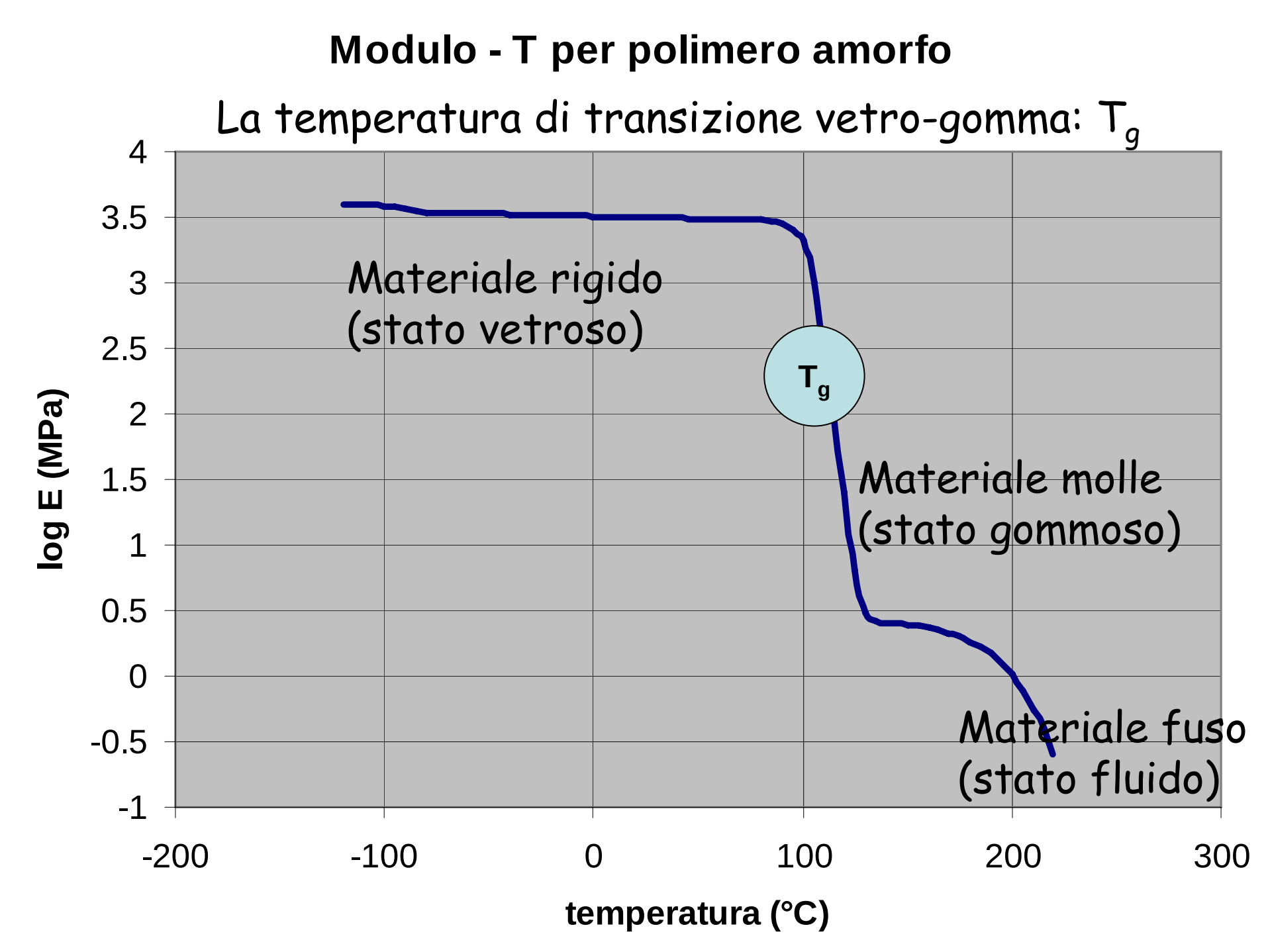
Teoria della elasticità della gomma



$$E_e = n_e RT$$

E_e = modulo elastico

n_e = numero di entanglement/cm^3

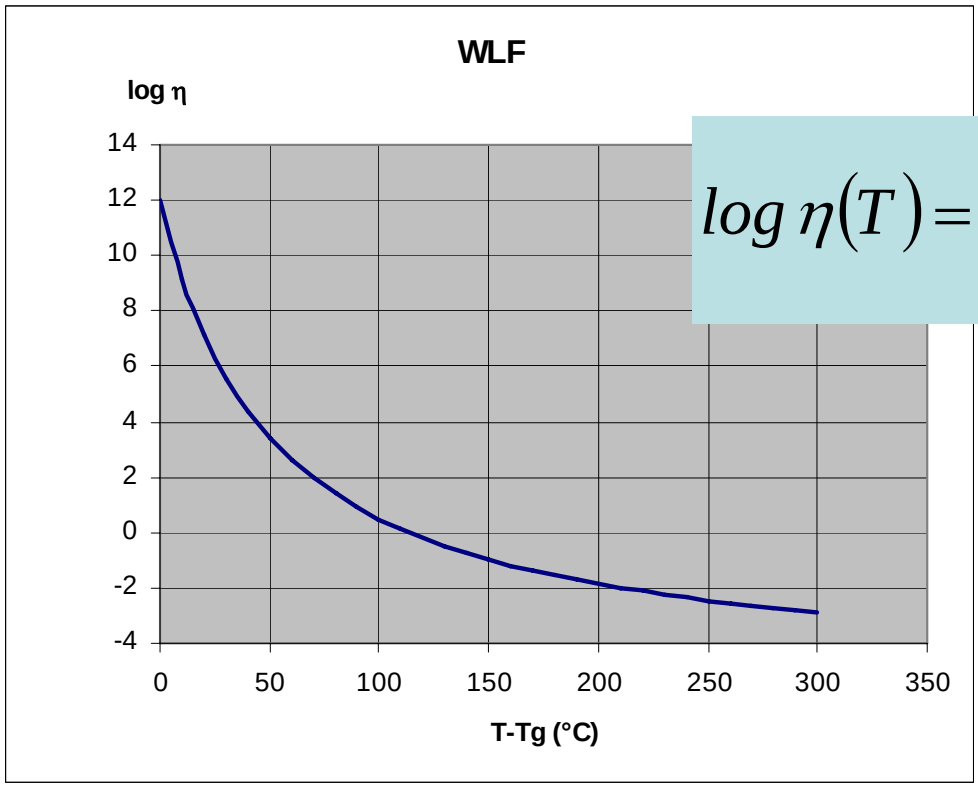

Modulo - T per polimero amorfo
La temperatura di transizione vetro-gomma: T_g
log E (MPa)
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-200
-100
0
100
200
300
temperatura (°C)
Materiale rigido
(stato vetroso)
T_g
Materiale molle
(stato gommoso)
Materiale fuso
(stato fluido)

La T_g é caratteristica di ogni specie polimerica

Materie plastiche	**T_g (°C)**
PVC	+ 80
Polistirolo	+100
PMMA	+ 100
Policarbonato	+ 150

Gomme (elastomeri)	**T_g (°C)**
Polibutadiene	- 100
Poli-isoprene	-56
SBR	-30 /-50

La T_g é la base per costruire teorie generali, valide per tutti i polimeri (teorie universali)



Equazione WLF

$$\log \eta(T) = \log \eta(T_g) - \frac{a(T - T_g)}{b + (T - T_g)}$$

$$a = 17.44$$

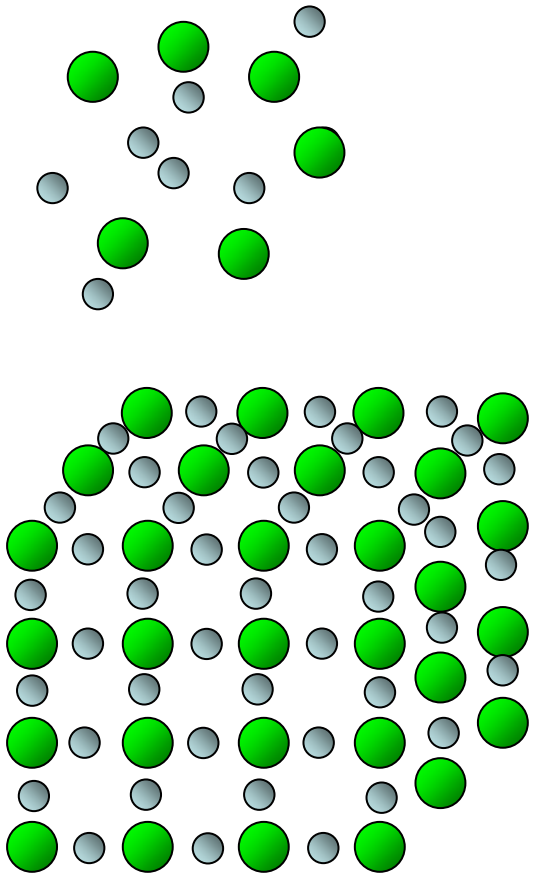
$$b = 51.6$$

La temperatura di transizione vetro-gomma, T_g :

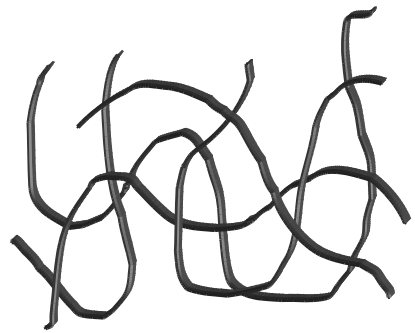
- é la temperatura alla quale tutte le proprietà fisiche cambiano drasticamente
- é caratteristica di ogni specie polimerica
- é la base per costruire teorie valide per tutti i polimeri (teorie universali)
- dal punto di vista termodinamico è una transizione del secondo ordine (disordine-disordine)

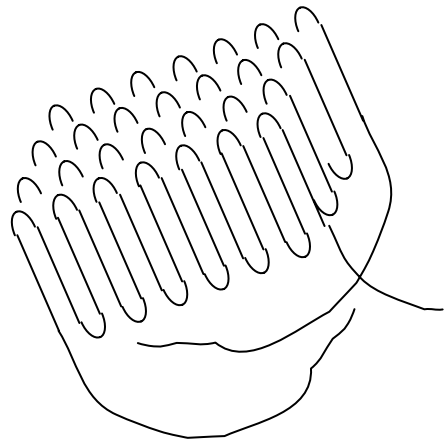
Materie plastiche cristalline

NaCl



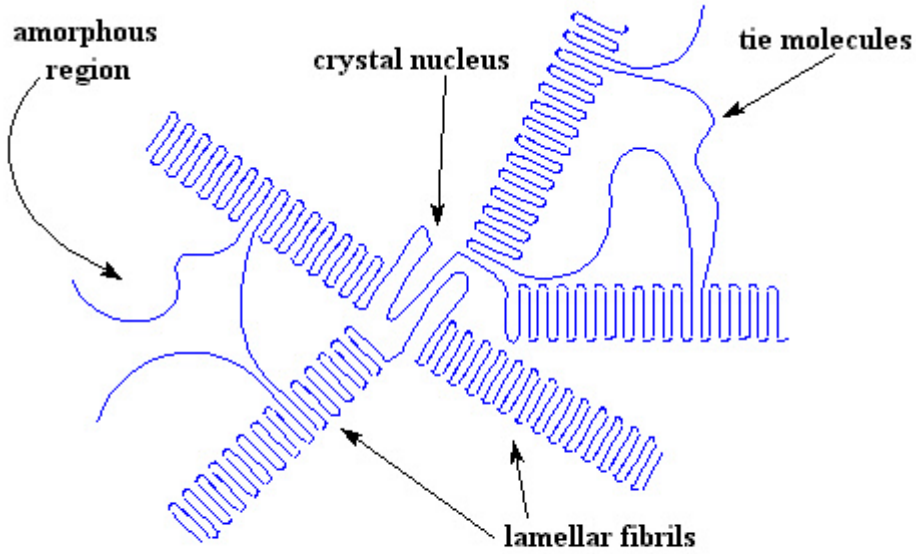
Polietilene



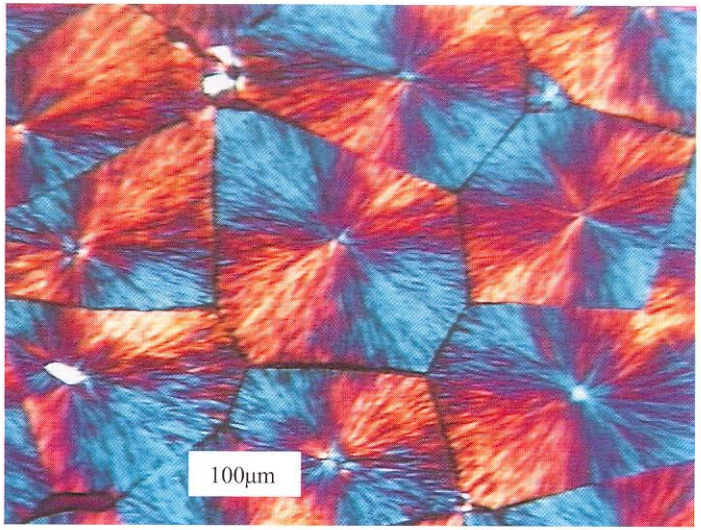


lamella

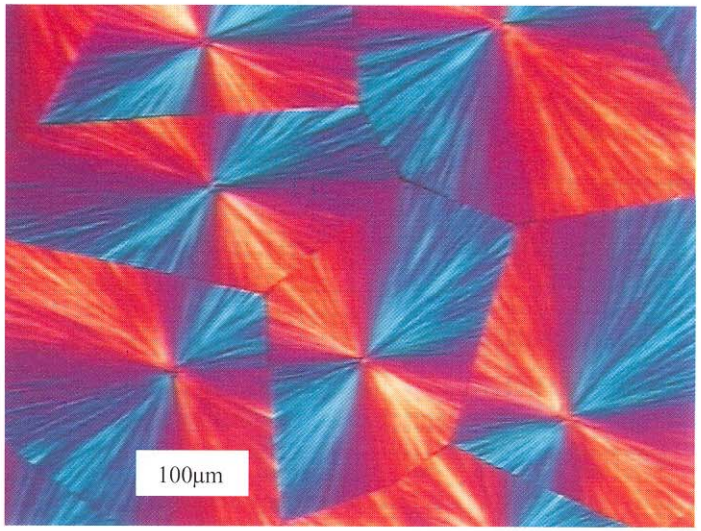
Materie plastiche cristalline



a polymer crystalline spherulite



Color Plate 3.1. Morphology of Type I spherulites of iPP homopolymer viewed by an optical microscope with cross-polarized light and 1/4 λ plate. Grown under isothermal conditions at 130 °C

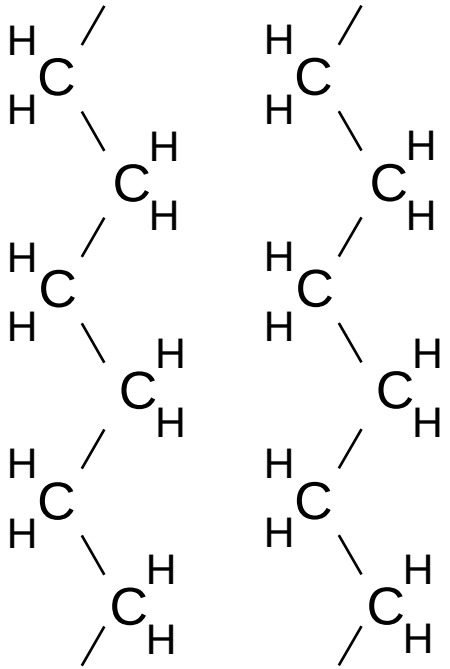


Color Plate 3.2. Morphology of Type II spherulites of iPP homopolymer viewed by an optical microscope with cross-polarized light and a 1/4 λ plate. Type II spherulite grown under isothermal conditions at 140 °C

Materiale	T fusione (°C)
Polietilene	130
Polipropilene	170
Poliammide 6	220
Poliammide 6,6	250
Polietilentereftalato	255
Teflon	320

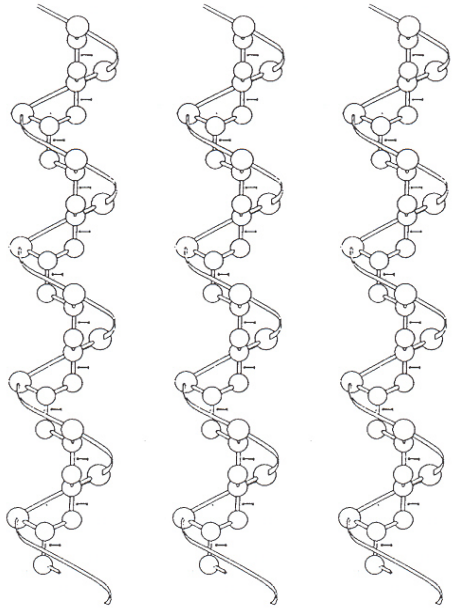
I cristalli di polietilene

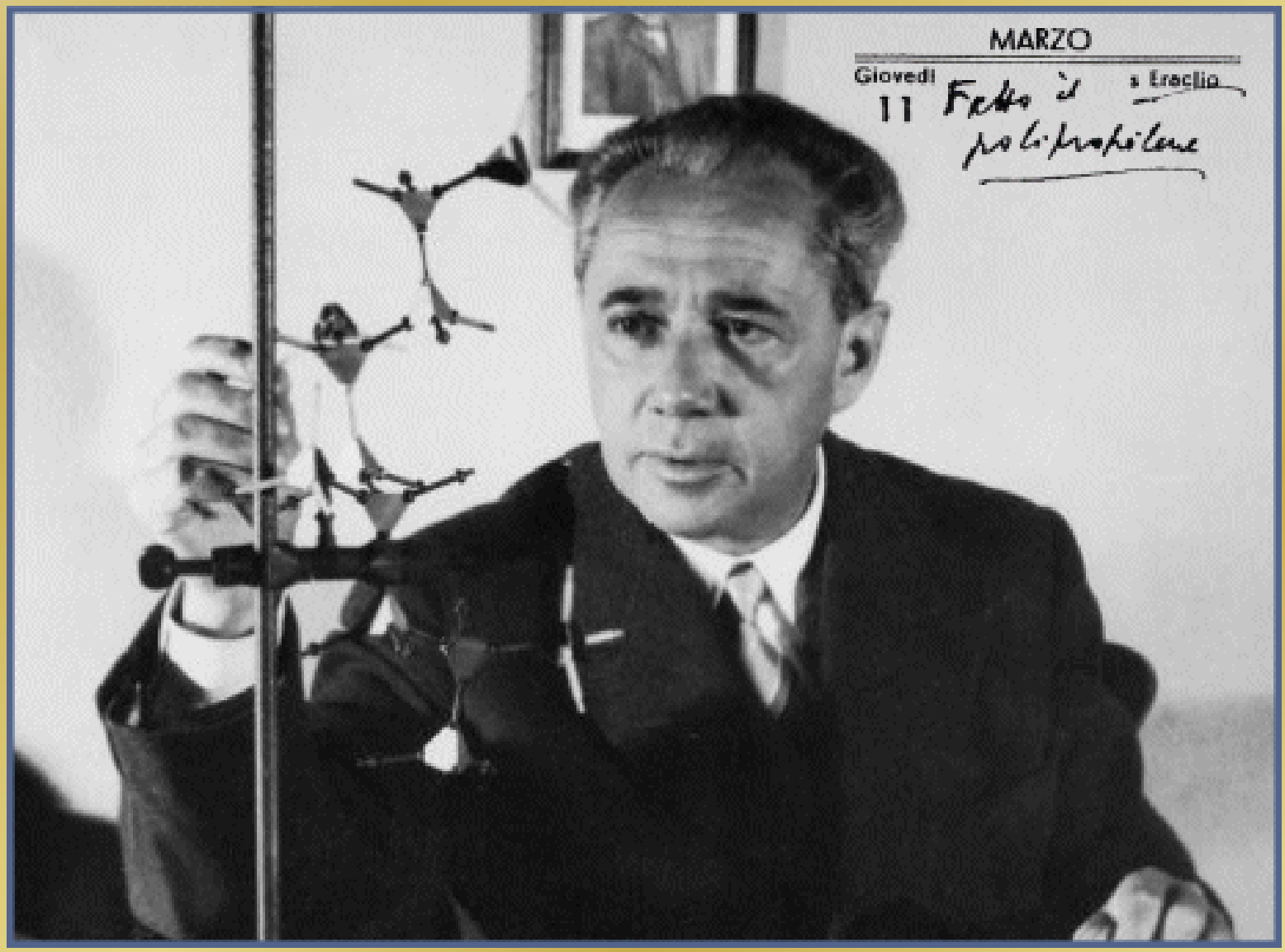
Struttura zig-zag planare



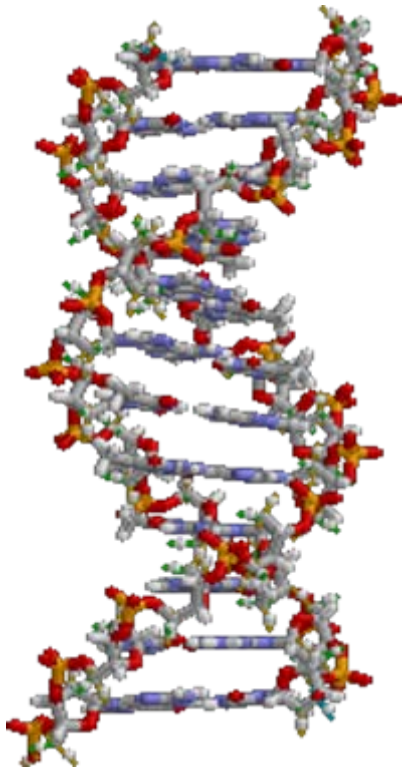
I cristalli di polipropilene

Struttura ad elica




MARZO
Giovedì
11
Fatto il
a Eraclia

La struttura del DNA

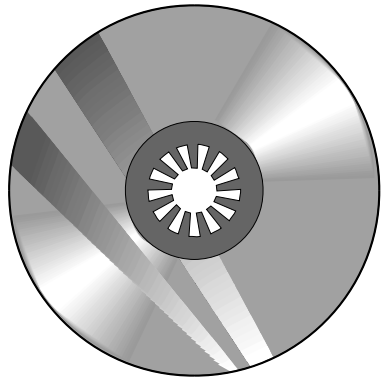


Proprietà ottiche dei polimeri

Poli metil metacrilato (*PMMA, plexiglass, vetro acrilico*)

Trasparenza

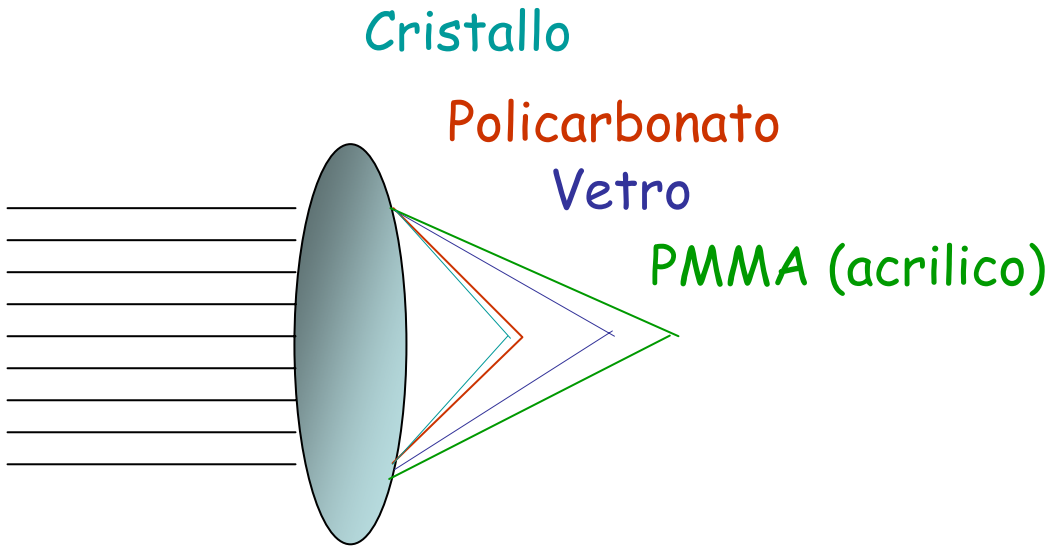
Materiale	Trasmittanza %
Vetro	**90**
Polistirolo	90
PVC rigido	87
PMMA	92
Policarbonato	88



Trasparenza e flessibilità

Indice di rifrazione

Materiale	Indice di rifrazione
PMMA (lastre acriliche)	1.49
Vetro	1.52
Policarbonato	1.58
Polistirolo	1.59
Cristallo	1.60



Lenti, Guide di luce, Fibre ottiche, LED

Lenti fotocromatiche in *vetro organico* (plastica)

dal sito Internet della società PPG

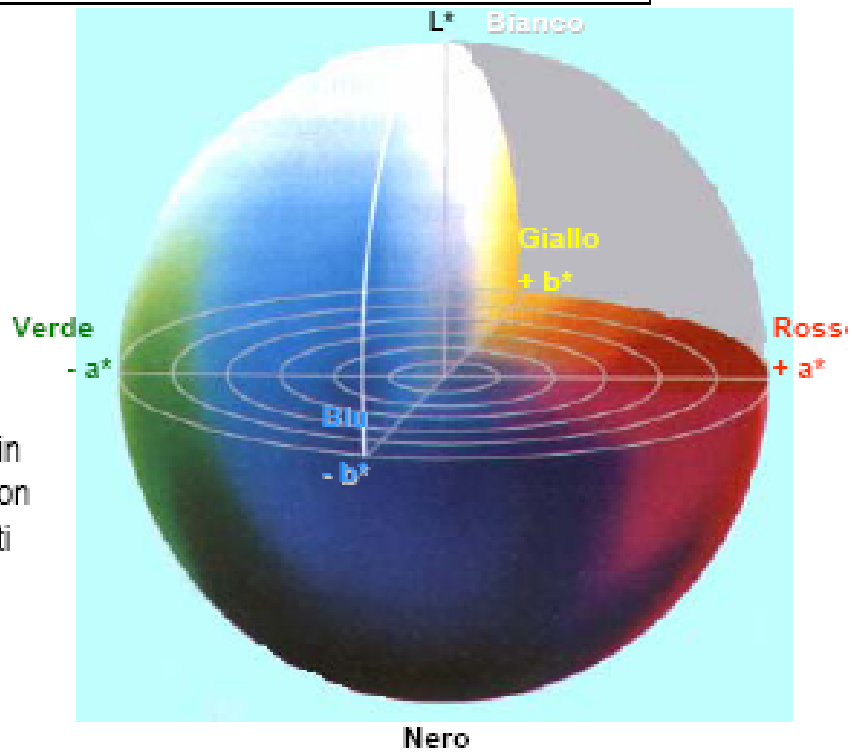
Mara Venier

La misura del colore

Spazio di colore CIE L*a*b*

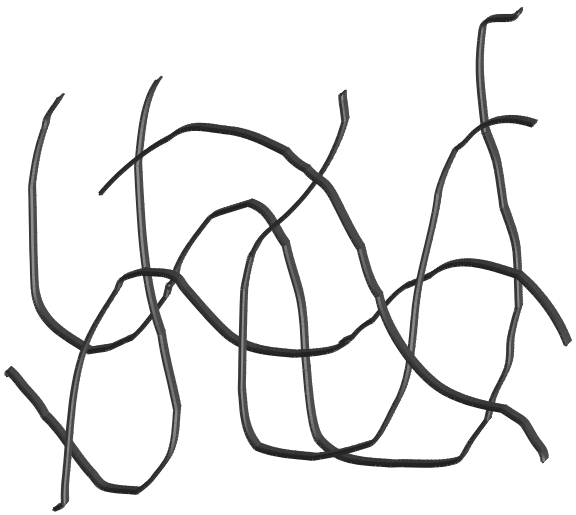
Il sistema CIE L*a*b* fu introdotto nel 1976. Tutti i sistemi di misura moderni si basano su questo

I colori sono mostrati in base alle differenze con le quali sono percepiti dall'occhio



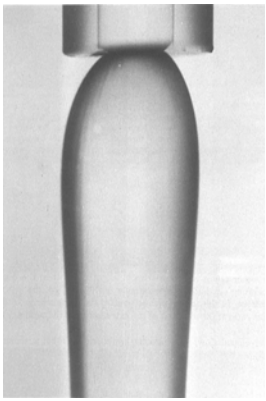
La fluidodinamica dei polimeri

'Reologia dei polimeri'



- Viscosità molto elevata
- Viscosità dipendente dalle condizioni di moto
- Effetti elastici e viscosi

Viscosità molto elevata

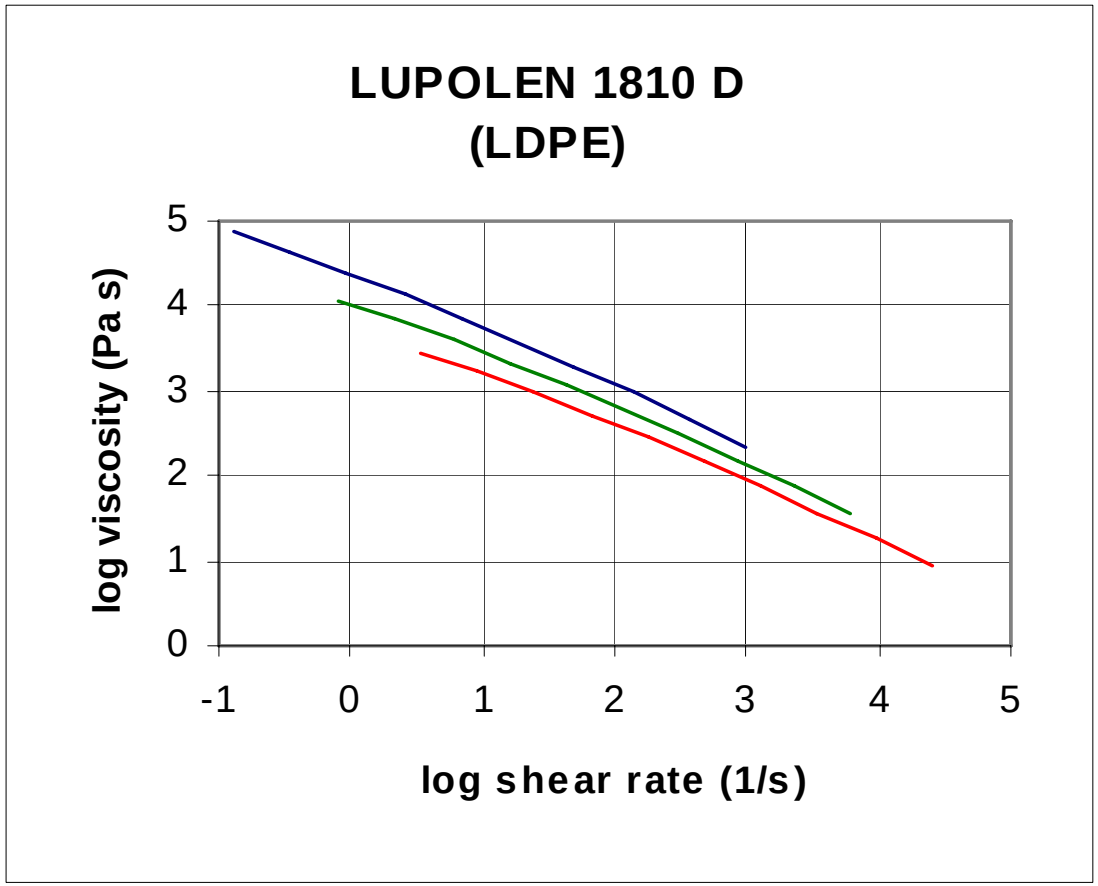


ALCUNI VALORI TIPICI DELLA VISCOSITA’	
MATERIALE	**VISCOSITA’ (Pa.s)**
Aria	10^{-5}
Acqua	10^{-3} (=1mPa.s)
Olio d’oliva	10^{-1}
Glicerina	10^{0}
Miele	10^{2}
Grasso lubrificante	10^{3}
Mat. plastica fusa	$10^{2} – 10^{6}$
Gomma	$10^{4} – 10^{8}$
Vetro	10^{21}

Viscosità dipendente dalle condizioni di moto

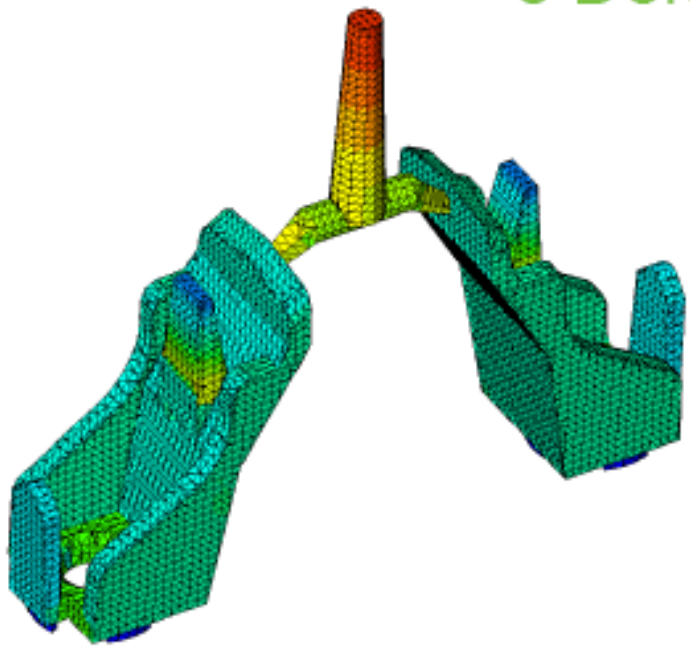
'Curva reologica'

T = 200°C
T = 220°C
T = 240°C



(Shear rate: è una definizione generalizzata della portata)

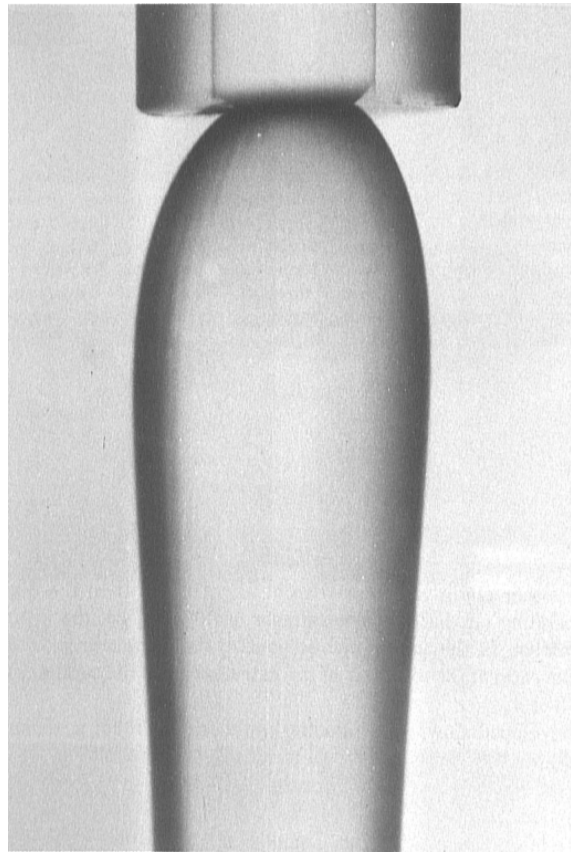
Analisi di Riempimento, Mantenimento e Deformazione



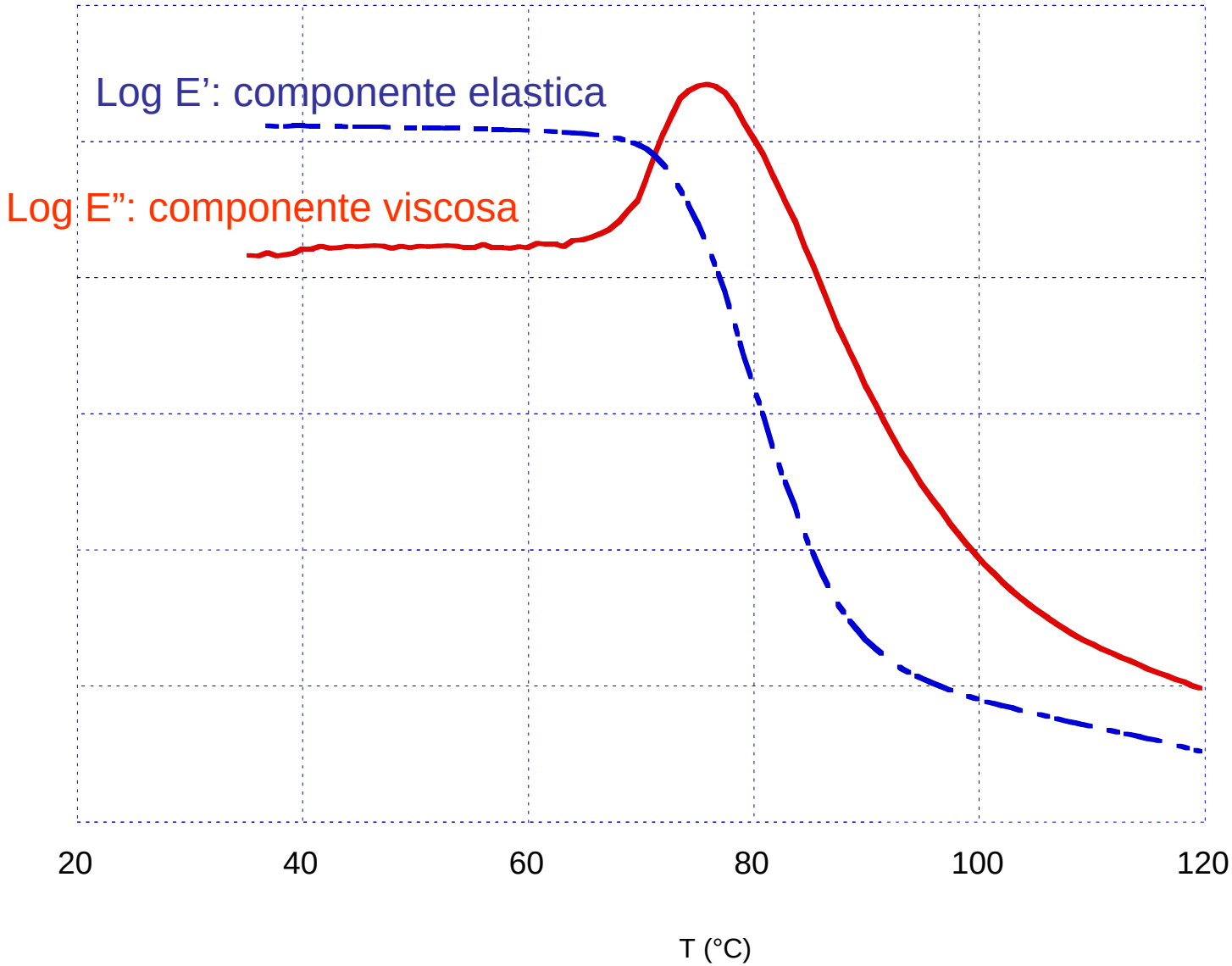
Spessore della parte automaticamente assegnato agli elementi del modello, e definizione dei canali triangolarizzati

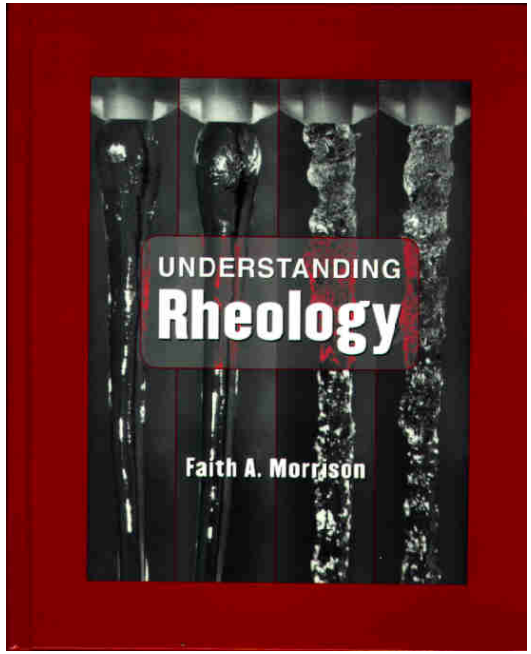
vero italia

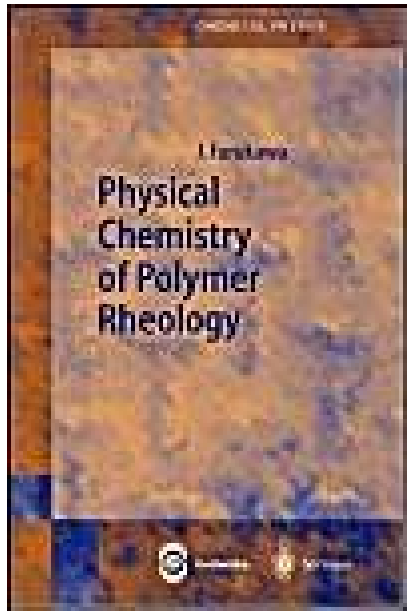
Effetti elastici e viscosi



Effetti elastici e viscosi




UNDERSTANDING
Rheology
Faith A. Morrison


Physical
Chemistry
of Polymer
Rheology

Fibre ad elevate prestazioni

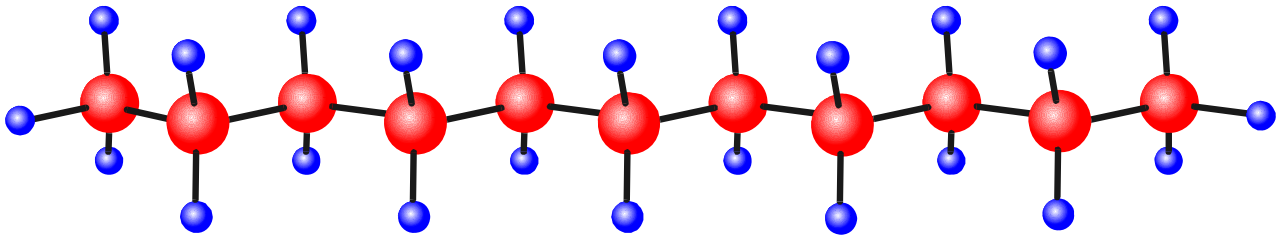
*‘The technologically-advanced 787 will use **20 percent less fuel** than today's airplanes of comparable size, provide airlines with **up to 45 percent more cargo revenue capacity**’*

Incidente a Felipe Massa. Una molla ha colpito il casco di Massa a 280 km orari

Fibre di carbonio

Energia del legame C-C = 348 kJ/mole

Polimero orientato




Tessuto di fibra di carbonio


Tessuto di Kevlar

… questi sono solo alcuni spunti di **FISICA DEI POLIMERI**…

Altri spunti:

- Polimeri conduttori di elettricità
- Elettreti
- Batterie litio-polimero
- Scintillatori per fotomoltiplicatori
- Leghe polimeriche
- Compositi con nanocariche…

Grazie dell'attenzione!

… se volete saperne di più….: g.locati@inwind.it