Laser-assisted growth of carbon nanotubes : control, modeling, optimization growth kinetics, applications

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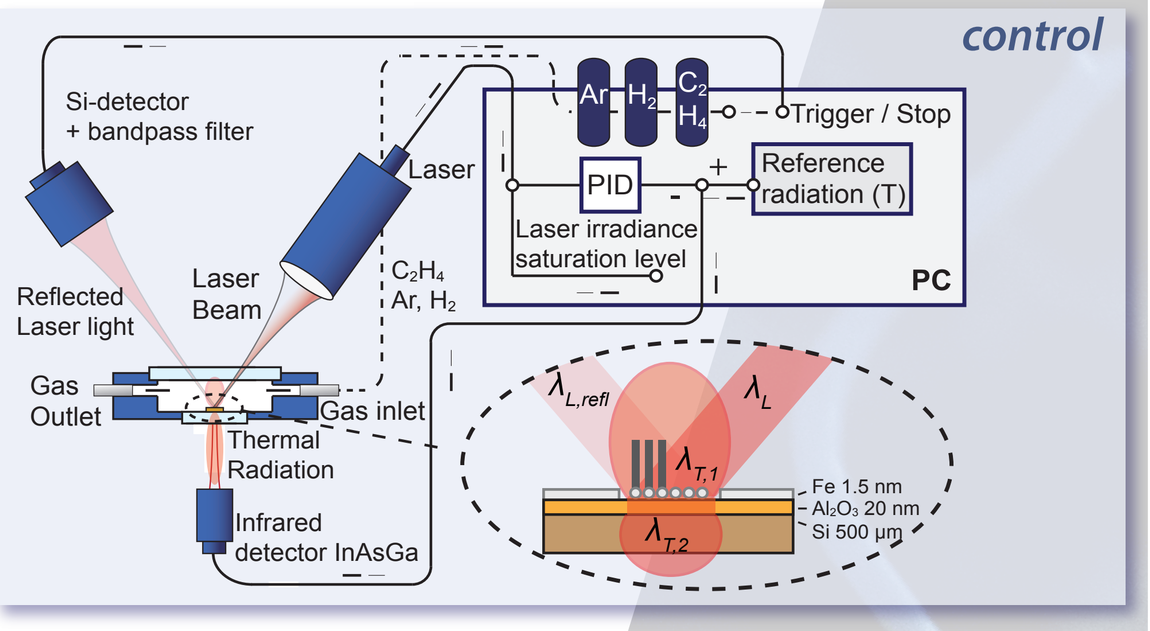
Introduction

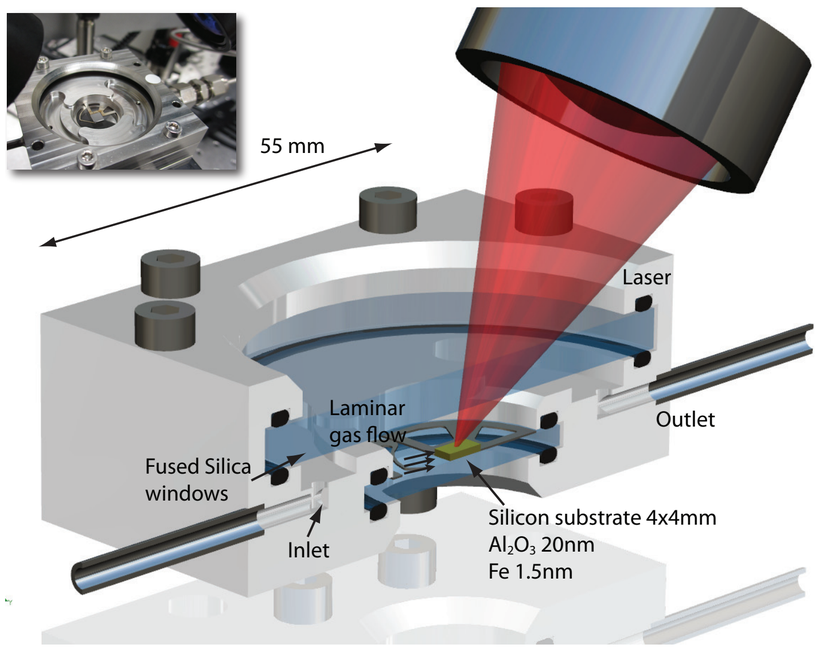
The fast localized growth of carbon nanotube structures has potential applications such as interconnects, field emitters and sensors but temperature evolution and process monitoring over time are often unavailable.[1] Proces is difficult to **control**.[2]

Optimization can be achieved by better understanding **growth kinetics** and catalytic mechanisms.

Miniaturized reaction chamber[3] for precise control of the composition of the laminar flow of process gases to study growth kinetics.

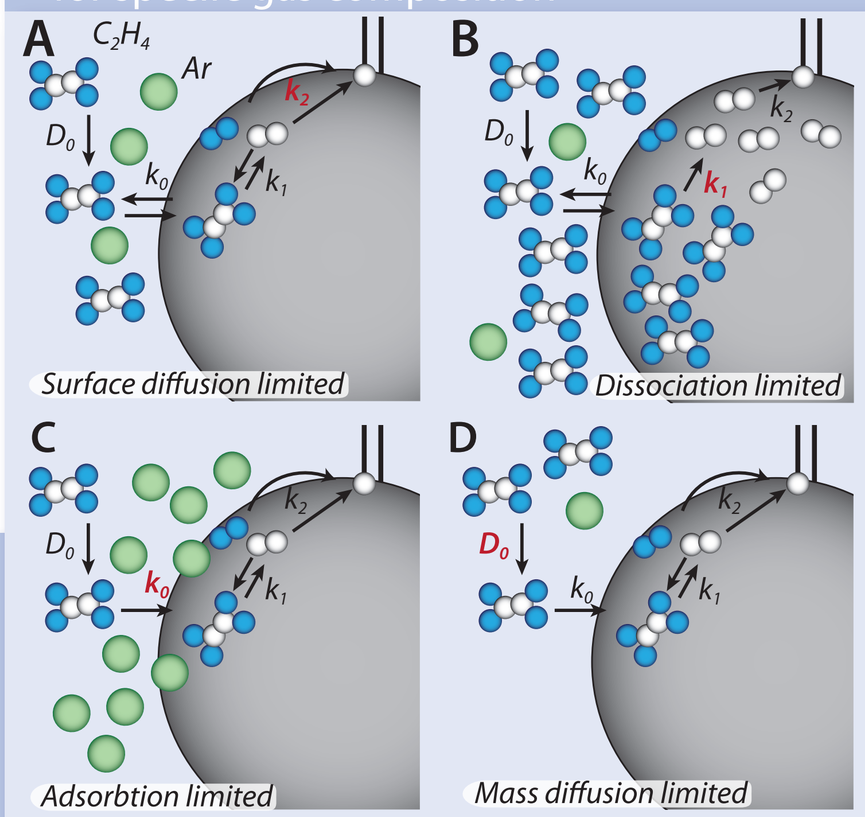
control

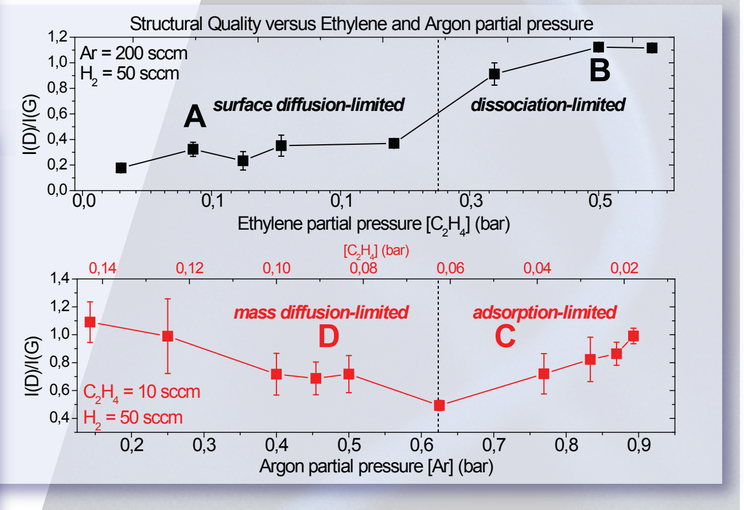


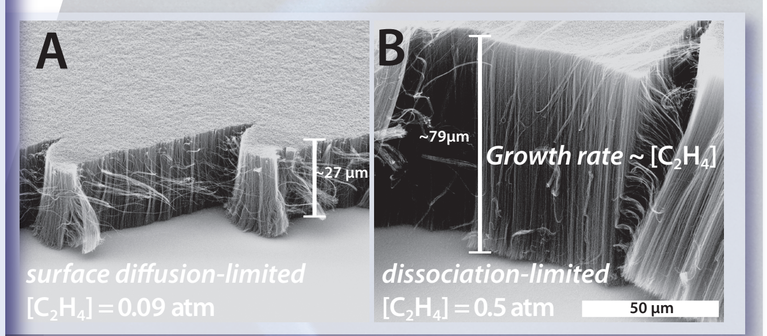


Growth Regimes *growth kinetics*

Linked to rate-limiting mechanisms for specifc gas composition



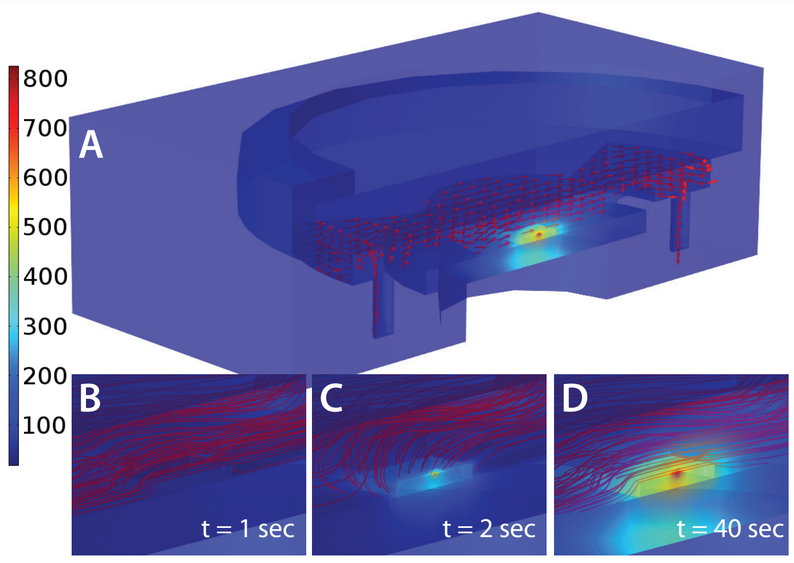


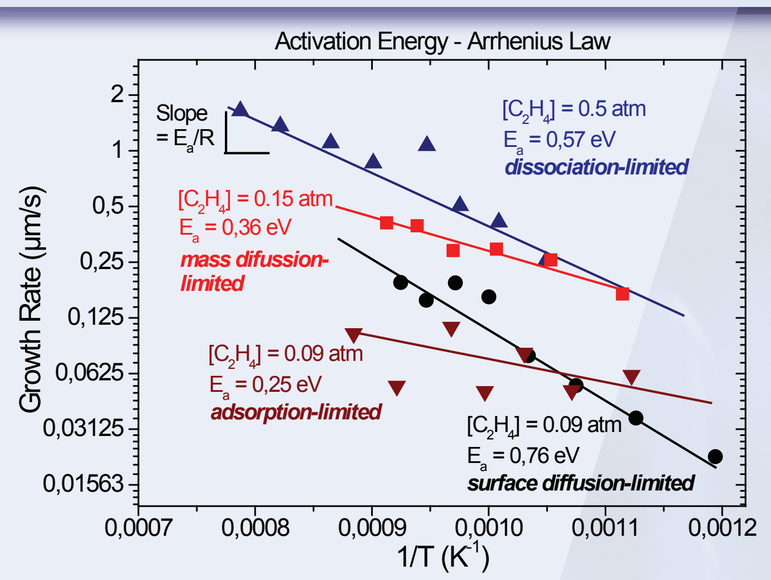


Thermal Model *modeling*

Heat and flow coupled simulation **evaluates** forced and natural convection as a function of input parameters such as gas flow and laser irradiance.[3]

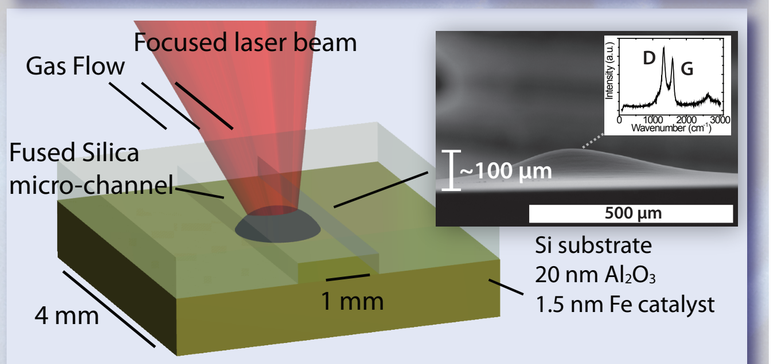
Radiation linked to temperature



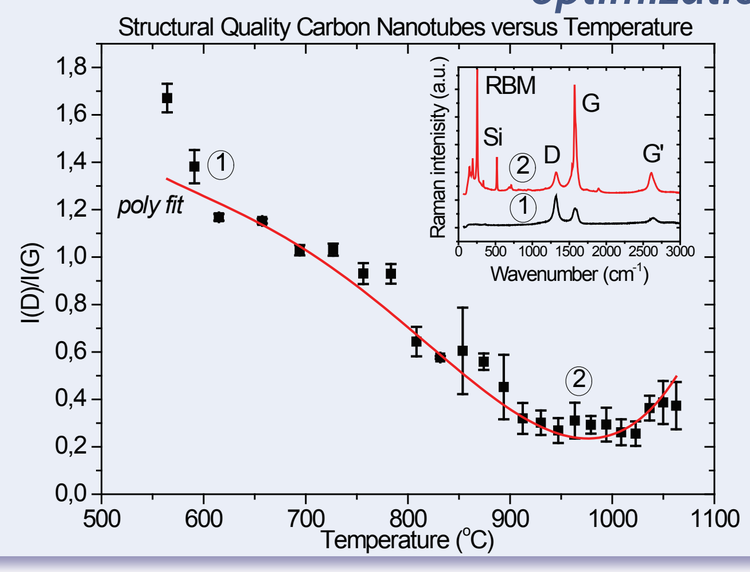


Channel growth *applications*

Direct local growth inside a partially sealed micro-channel.[4]



optimization



Conclusions

Rapid and ***controlled*** growth of local carbon nanotubes using ***miniaturized*** reaction chamber

Temperature evaluation using FEM, structural optimization

Investigation of growth ***kinetics*** and ***rate-limiting*** mechanisms

Local growth inside ***micro-channel***

Outlook

Dynamical evaluation of growth rate using absorbance spectrum

Femto-second laser patterning of catalyst and carbon nanotubes

Further optimization

1. Haluška *et al*. Nanotechnology 21, (2010).
2. van de Burgt *et al*. J. Appl. Phys. 112, (2012).
3. van de Burgt *et al*. Proc. LPM (JLPS), (2013).
4. van de Burgt *et al*. AIP Adv. 3, (2013).

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