

ECR-plasma precision etching

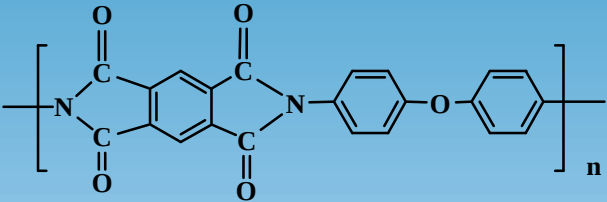
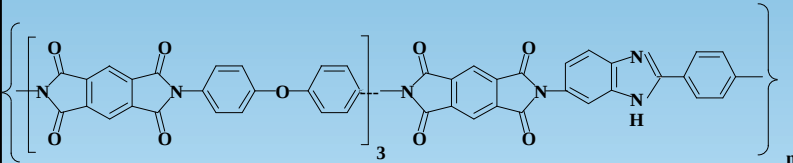
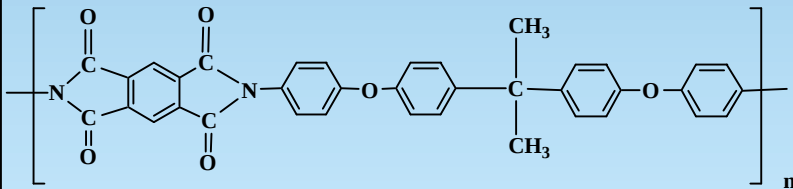
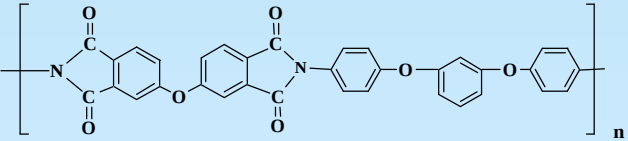


ECR etching allows us to control a hair profile angle and aspect ratio. The pillar aspect ratio is varied by applying 13.5 MHz RF to the etcher wafer chuck forming a negative DC self-bias on the substrate due to the different mobility of electrons and ions.

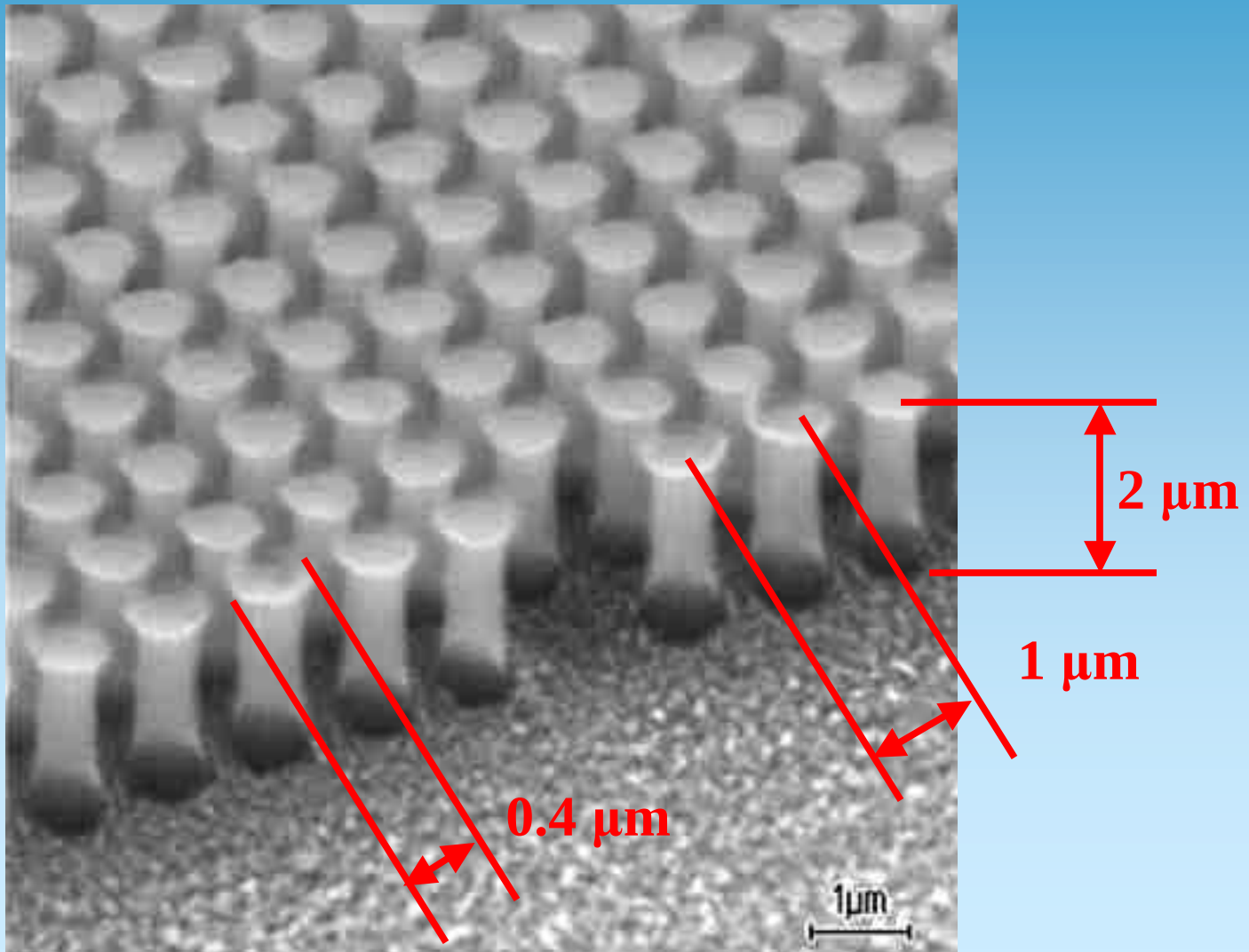
High ion density: $10^{12} - 10^{13} \text{ cm}^{-3}$

Low operating pressure: up to 0.2 mTorr

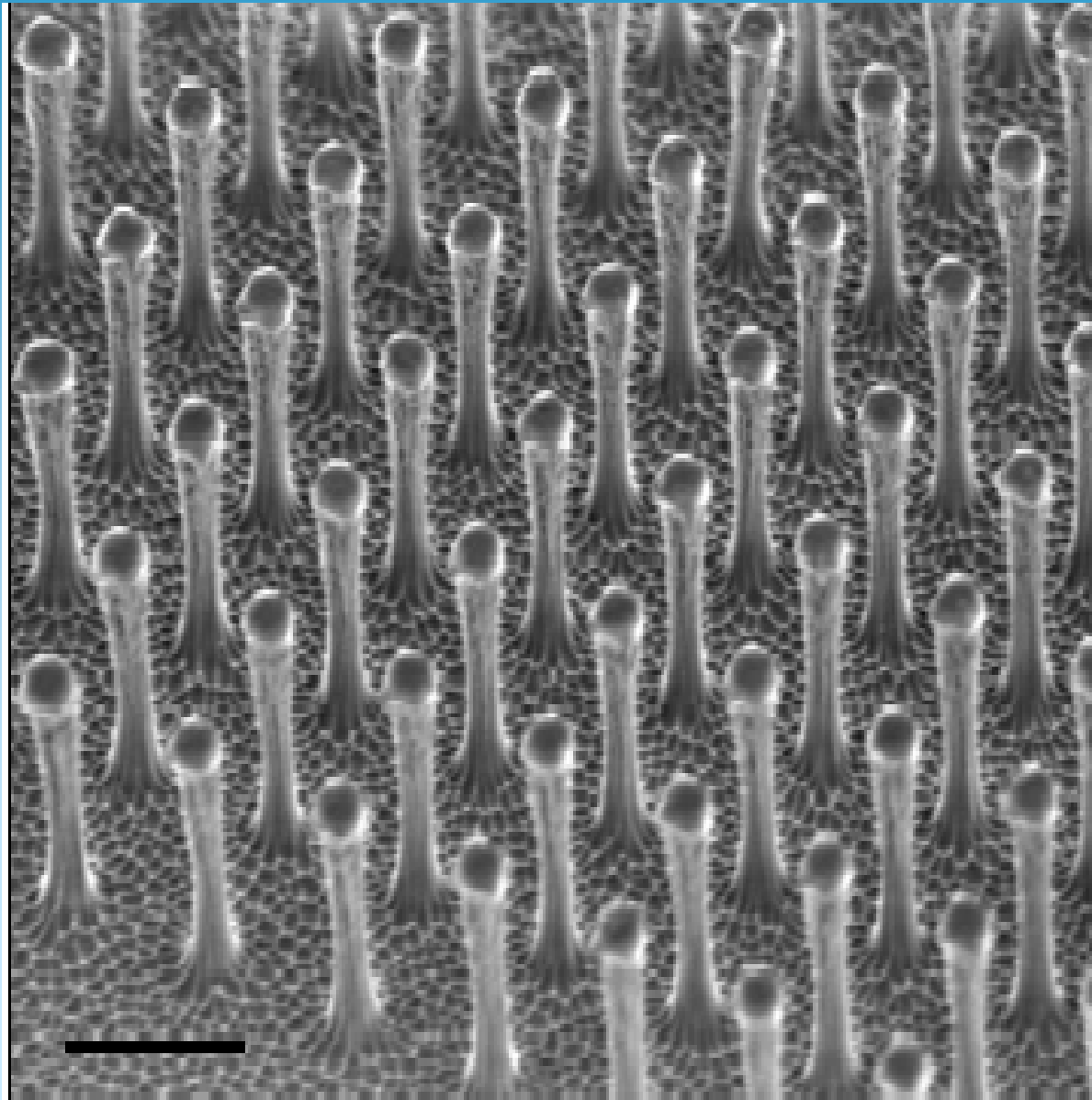
Example of Different Modifications of Polyimide Used

Polyimide	Monomers
	Pyromellitic dianhydride (PMDA)-4,4'-oxydianiline (ODA)
	PMDA-ODA-2(p-aminophenyl)-6-aminobenzimidazole (M)
	PMDA-Diaminophenyl ether of bisphenol A (A)
	Oxydiphenyl 3,3',4,4'-tetracarboxylic acid dianhydride (ODPA)-Diaminodiphenyl ether of resorcinol (DR)

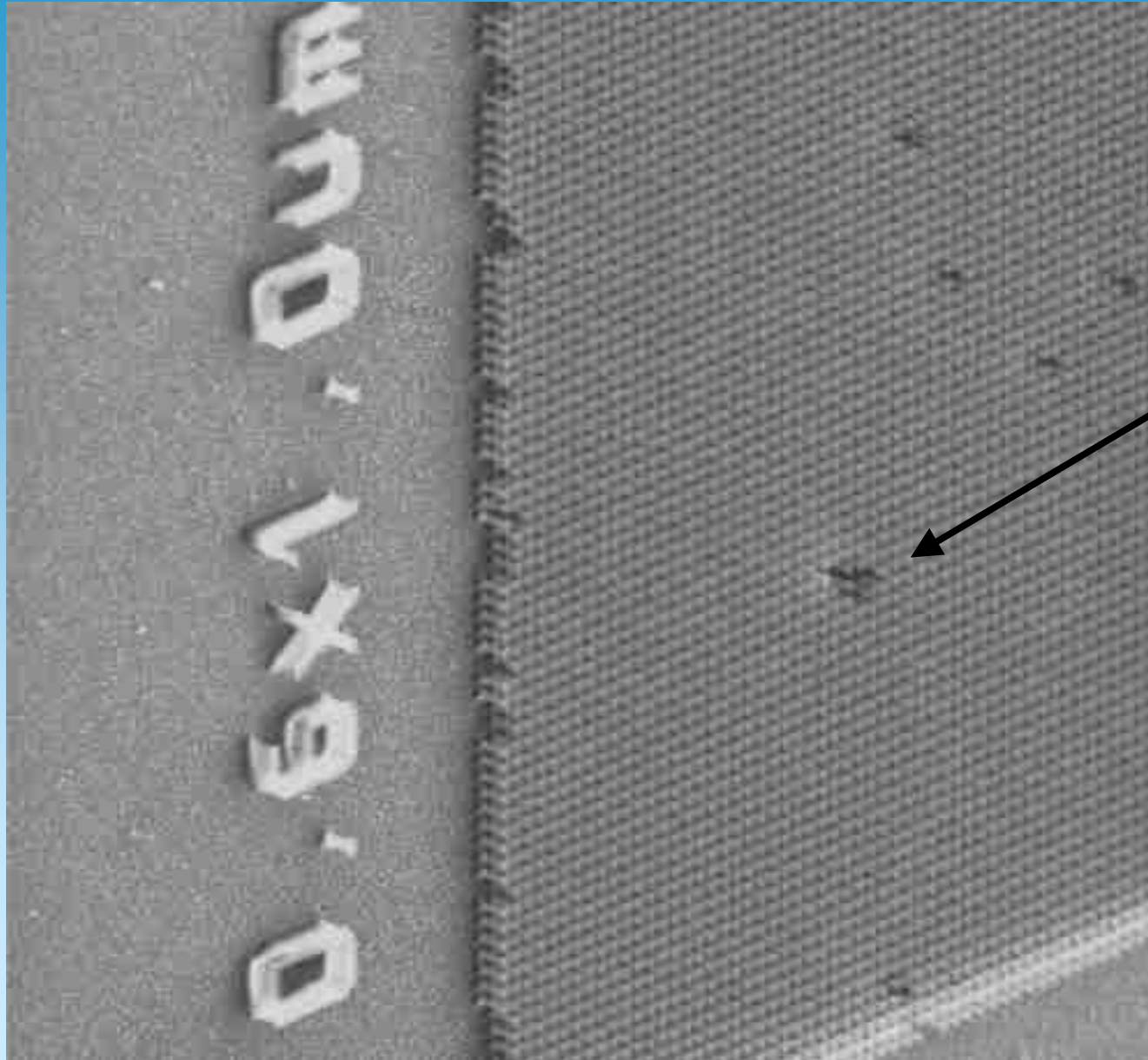
Optimal gecko hair array geometry



Gecko hairs with spherical cap

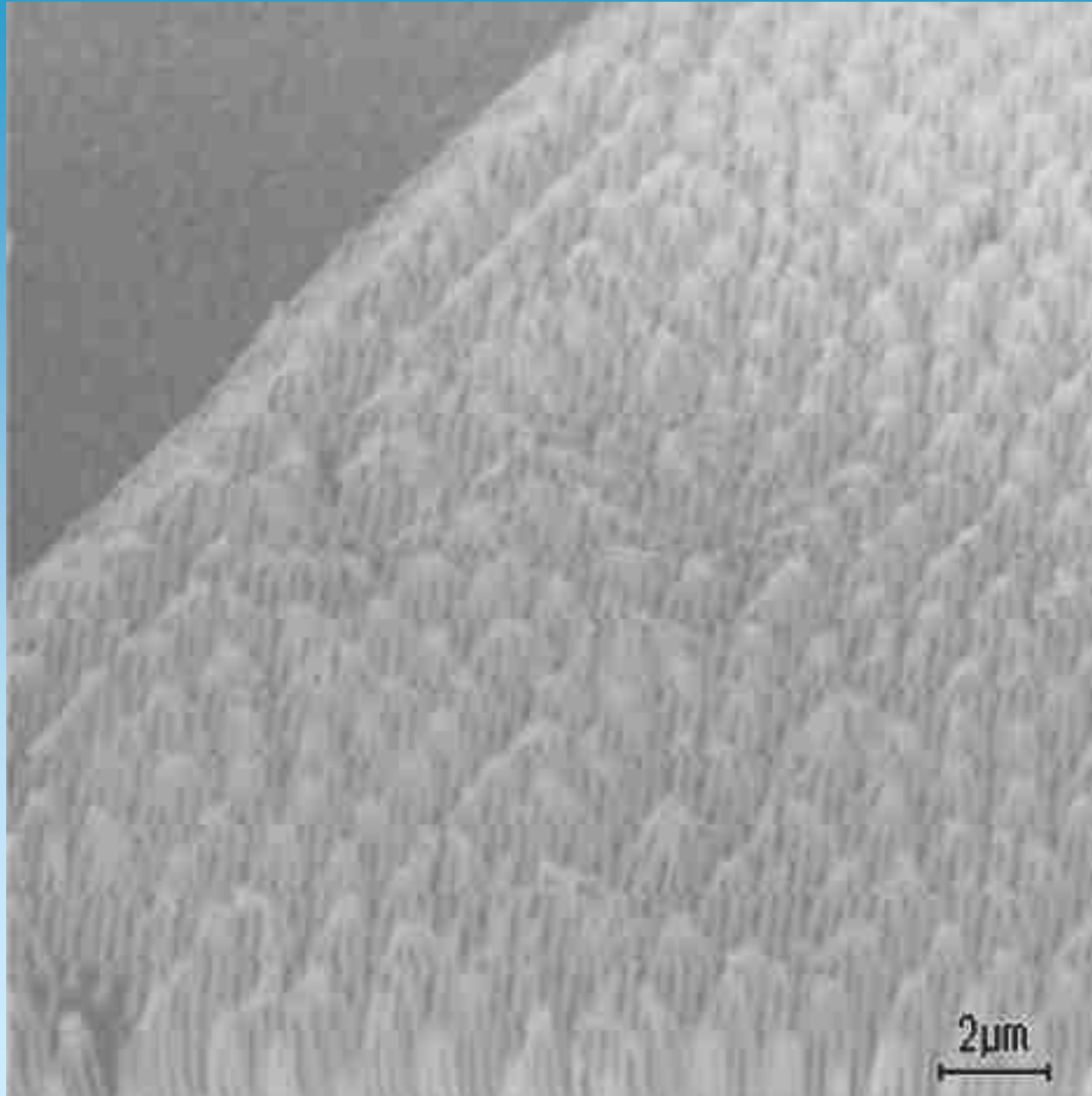


Large area gecko hair array



Stacking
fault

Thin and long hairs



Gecko hairs after sixth contact

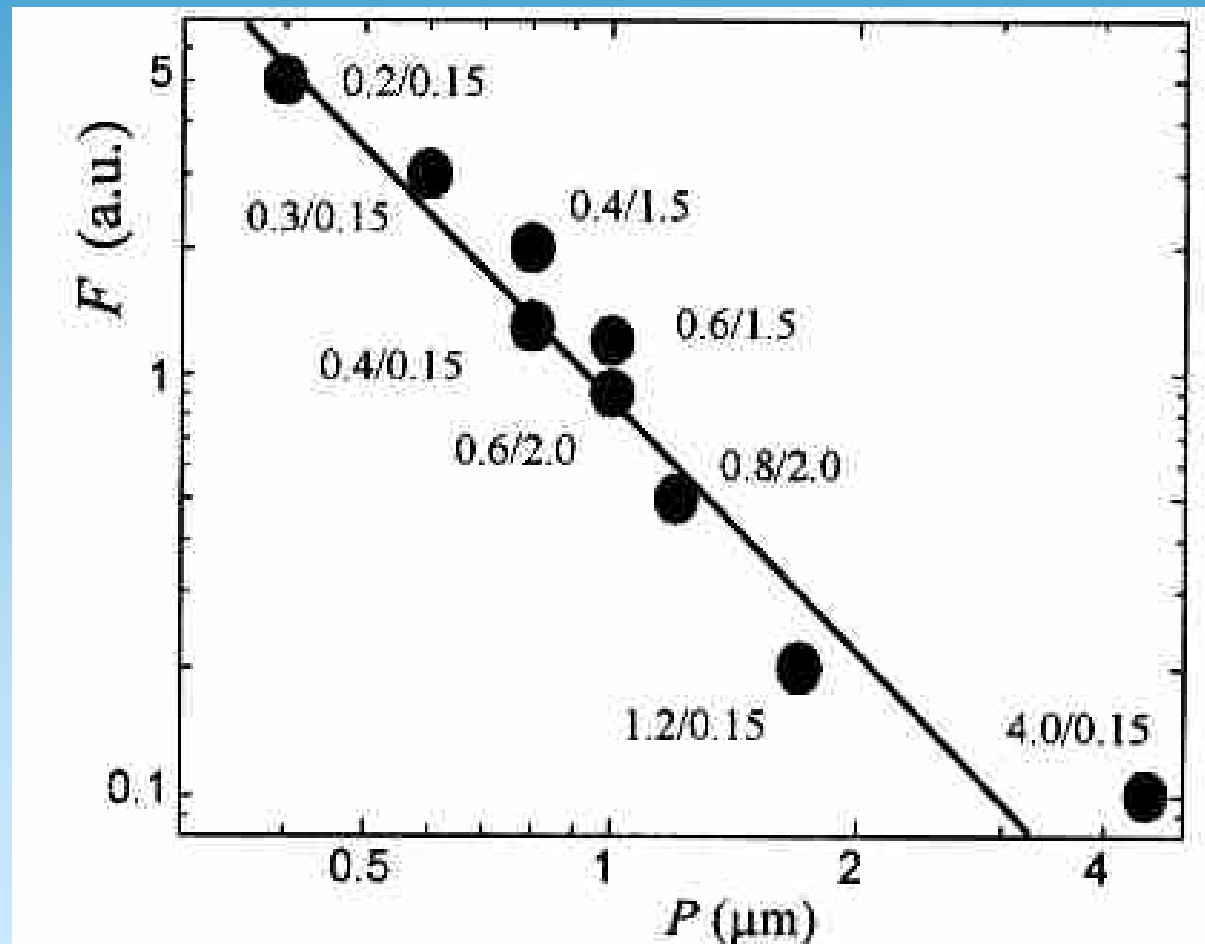


We have to develop
“goose skin”
technology

Parameters investigation

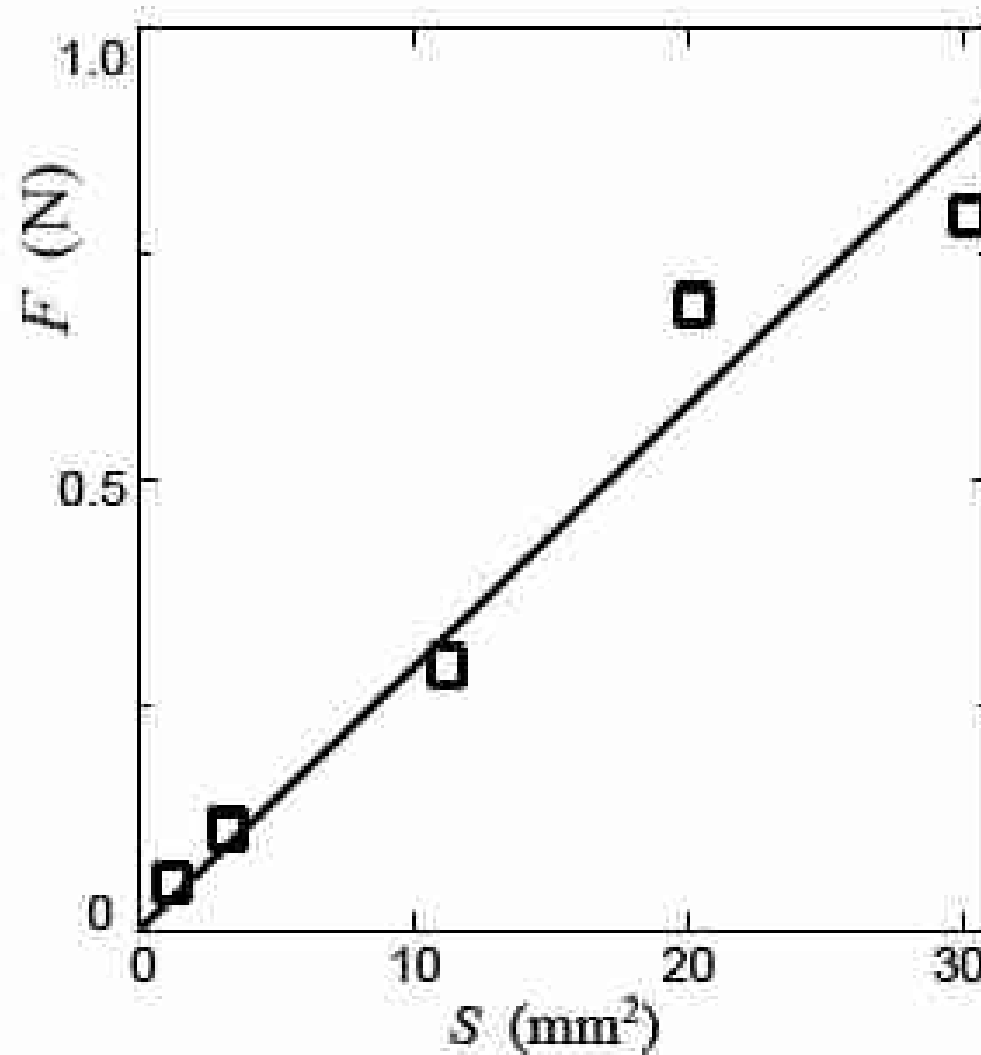
Then we measured the perpendicular force F required to detach the samples from SiO_2 surface (this work was carried out by the Manchester University group). This was done using an atomic force microscope (AFM) in the force mode. The adhesion between the samples and a flat tip (about $50\text{ }\mu\text{m}$ in size) was found to depend strongly on the initial preload. For all measurements we used the same preload of about 10 mg.

Perpendicular force F required to detach various samples of polyimide hairs from a silicon surface. The experimental points are marked by D/H, indicating hairs diameter D and heights H respectively.



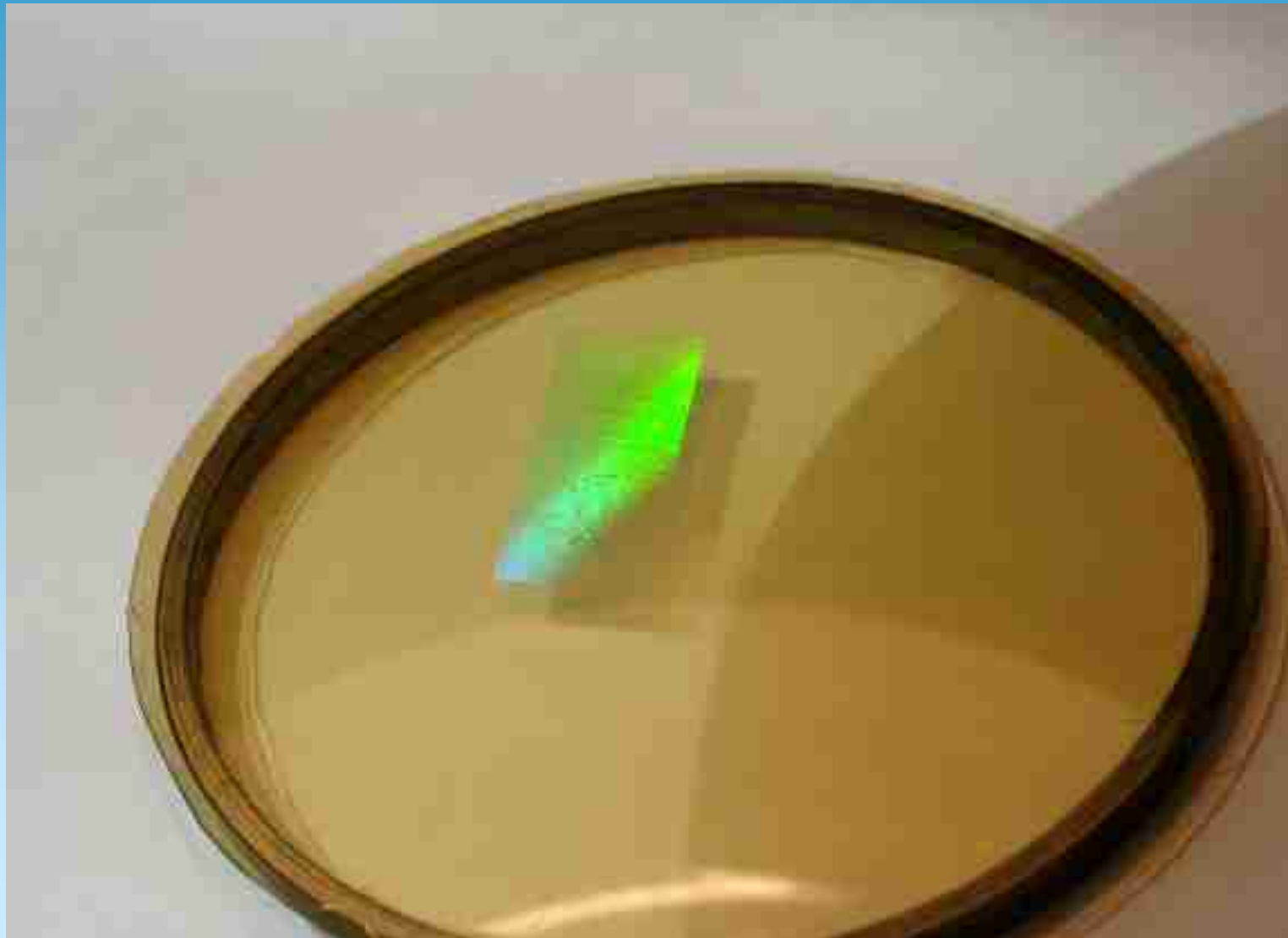
Period P is the main parameter (each pillar still has single point contact with surface)

Dependence of adhesive force on probe area is linear



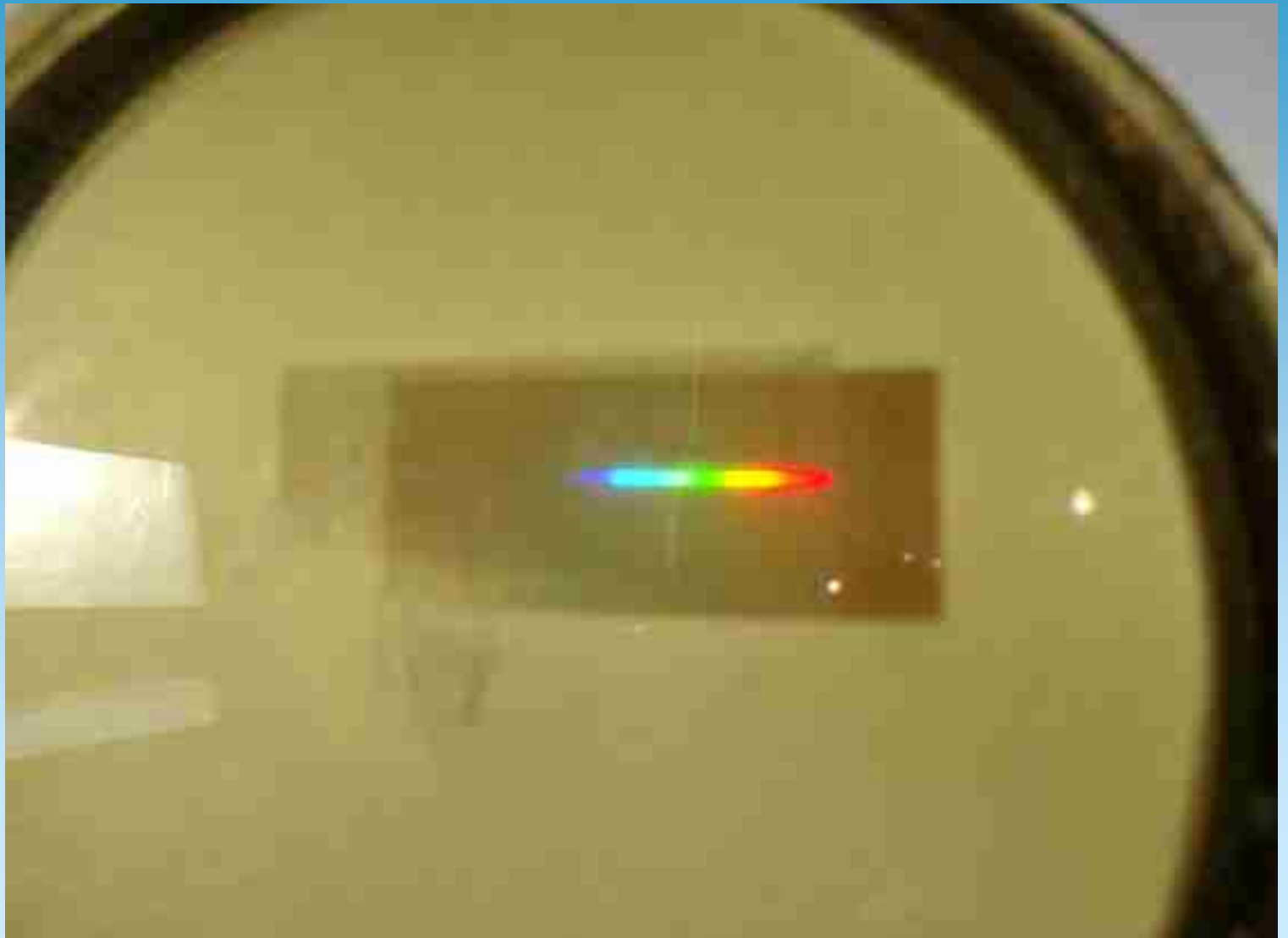
Gecko hair array on flexible transparent substrate

Lamp



Gecko hair array on flexible transparent substrate

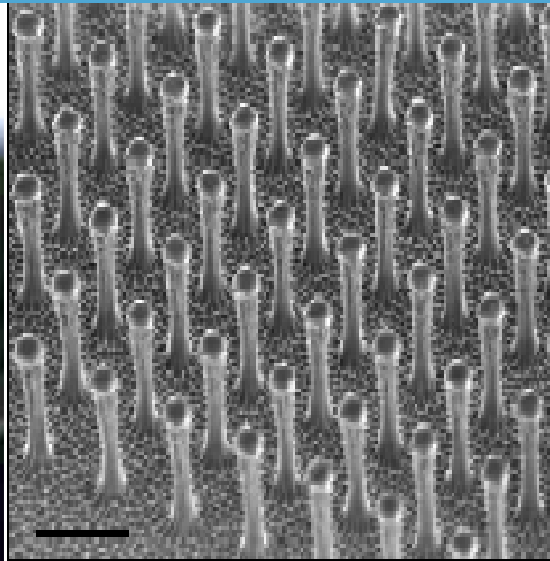
Sunlight



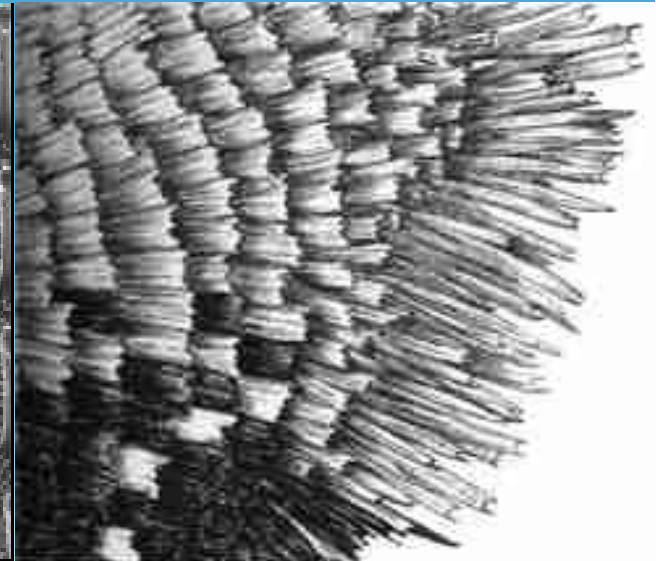
Butterfly colour



Apollo



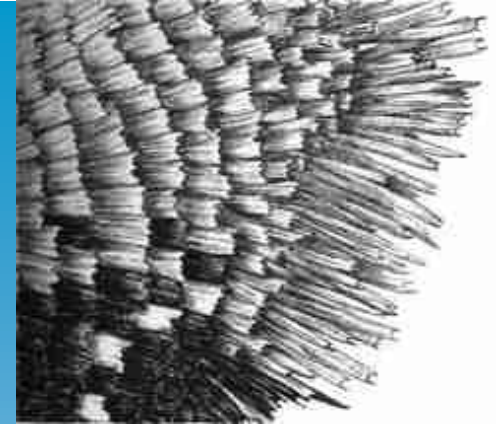
Gecko hair array –
photonic crystal?



Structure of the
butterfly pillars



Butterfly colour



Wings are the most important systematic characteristic of the branch of the butterfly: they are covered with squams whose structure and arrangement determine the fancifulness of color. Therefore, butterflies are called lepidopterous. Squams are transformed hairs. Good evidence for this is close examination of the squams cover of *Parnassius appolo*. Squams color depends on pigment granulas present in it; its external surface is ribbed. Apart from these pigment squams many butterflies, especially tropical whose wings display iridescent metallic color, have squams of another kind, optical.

Blinking butterfly (passion vine butterfly)



Left Handed Material



Conclusions

Re-attachable dry adhesives based on the gecko principle can find many applications.

Nature Materials, June 2003

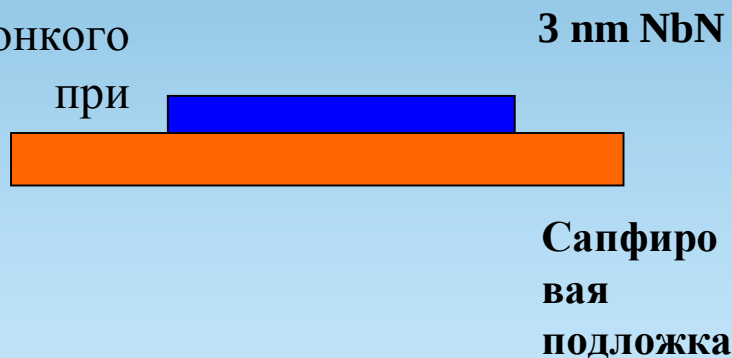


400
g/cm²

- Science
- Art (ballet, painting, ...)
- Micromechanics
- Space equipment
- Clothes
- Household
- Toys
- Optics
- Others

Регистрация одиночных фотонов

Как сохранить
основные
параметры тонкого
NbN
изготовлении
сенсора ?

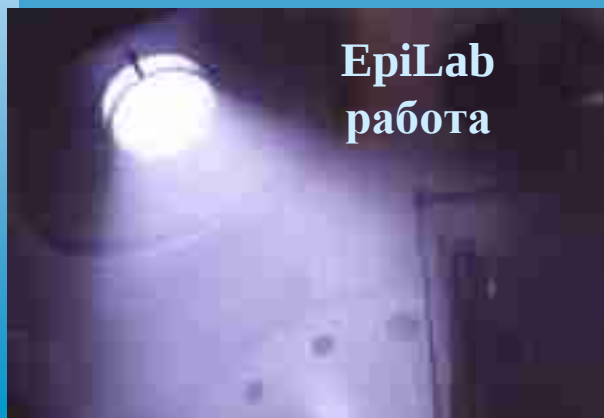


ECR-plasma silicon nitride
deposition and etching

Приемник терагерцового диапазона излучения



ВЫВОДЫ



ЕpiLab
работа



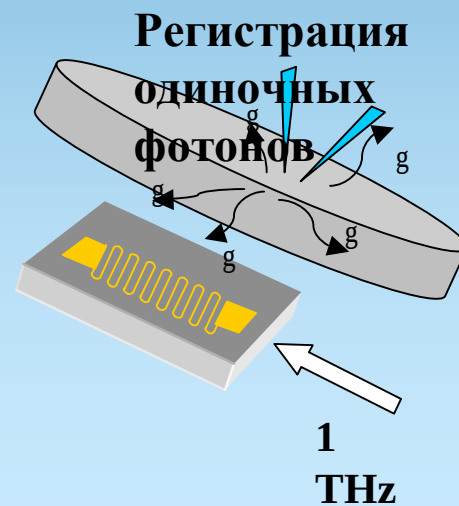
AlGaIn
транзистор



Неохлажда
емый
болومتر



Microfabricated
adhesive
mimicking
gecko foot-hair



исследования были поддержаны



РАН

Грант 01.20 00 00 763, “Физические и технологические основы эпитаксии, осаждения многослойных структур и наноструктурирования”

Грант программы РАН “Физика и технология наноструктур”

Министерство промышленности, науки и технологий

Грант “Исследование физических основ и разработка технологии СВЧ мощных транзисторов на основе широкозонных материалов”;

Грант “Исследования перколяционных и квантовых эффектов effects в квази-2D системах”



**Министерство промышленности,
науки и технологий**
Российской Федерации

исследования были поддержаны



Российское агентство систем управления

Контракт “Исследования и разработка основ технологии транзисторов с размерами элементов менее 0.1 μkm ”



Science & Technology

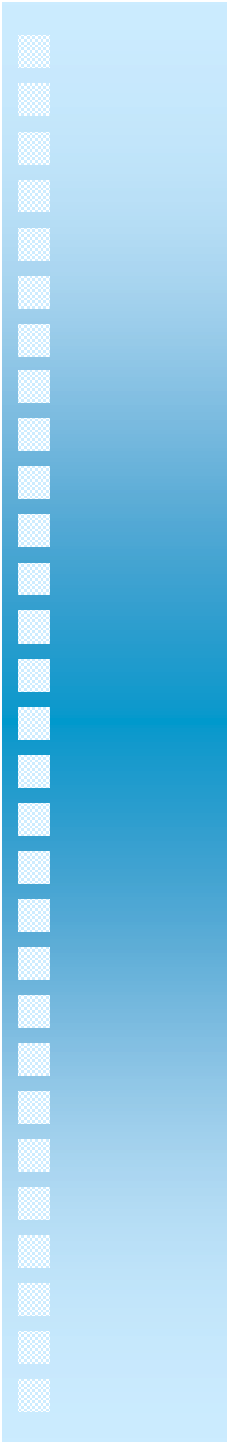
Офис военно-морских исследований США

Грант программы “Широкозонные полупроводники”



CNRS, Франция

Грант “ЭЦР-плазменно стимулированная пассивация широкозонных транзисторов”



Спасибо за внимание