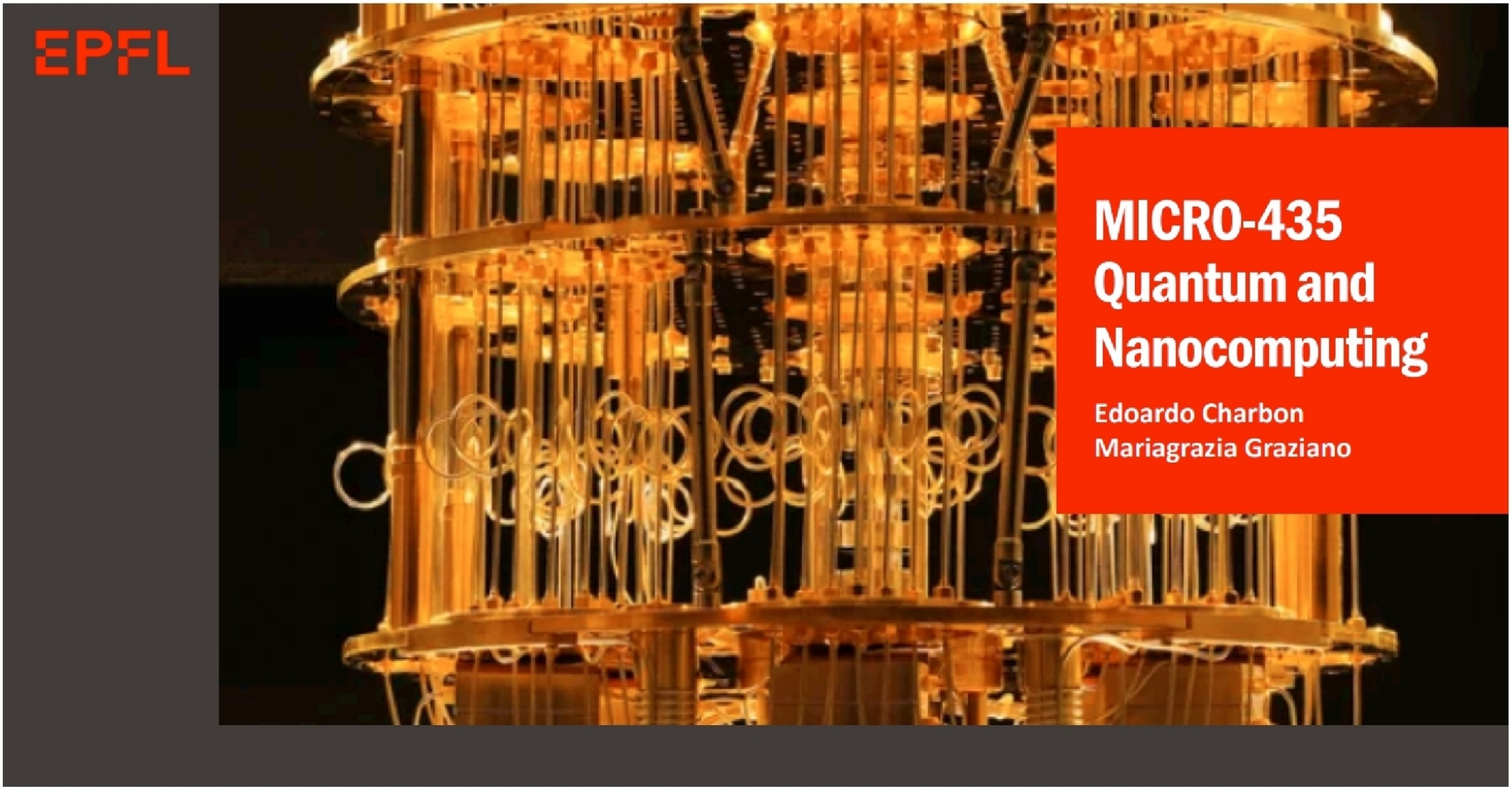
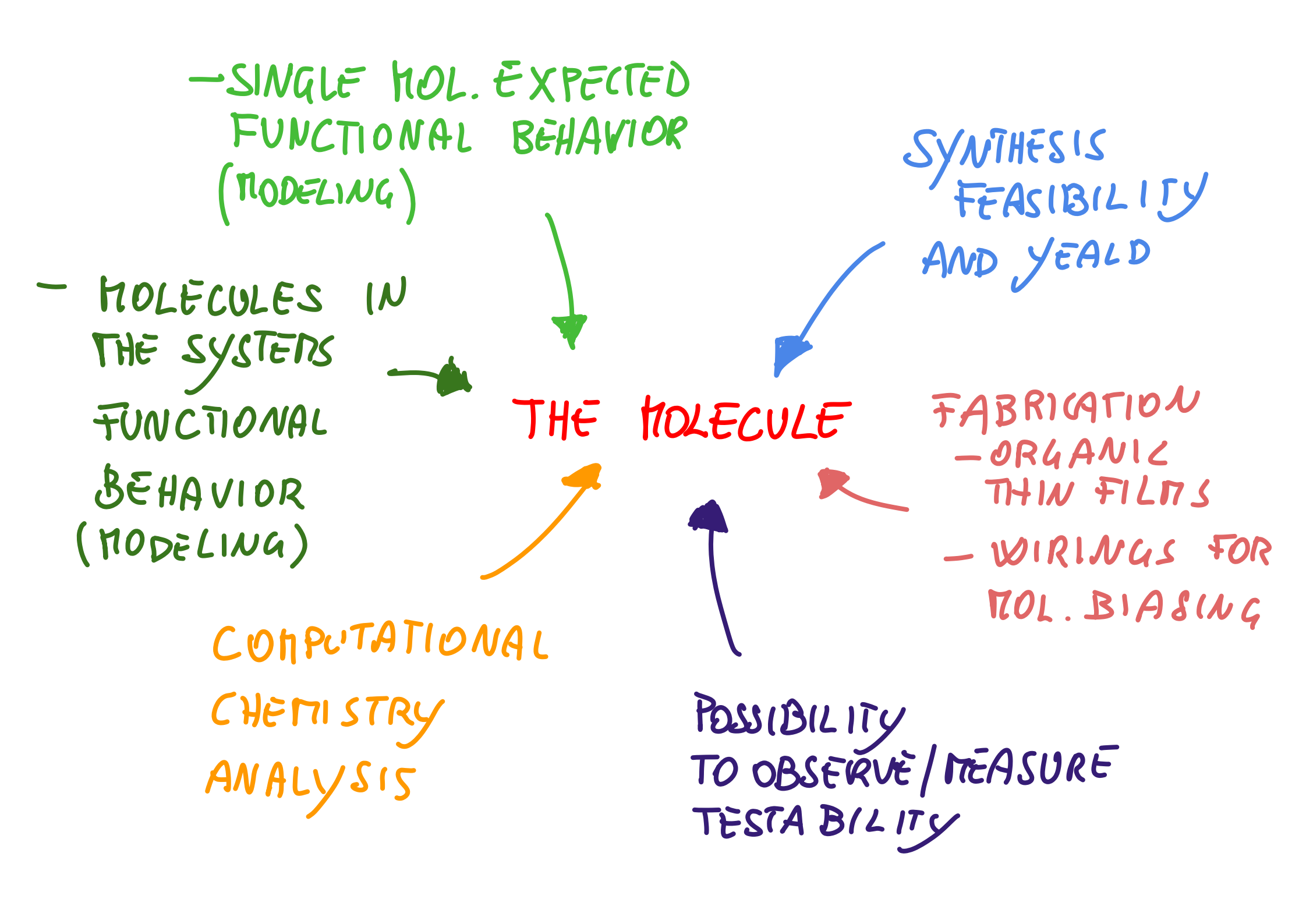


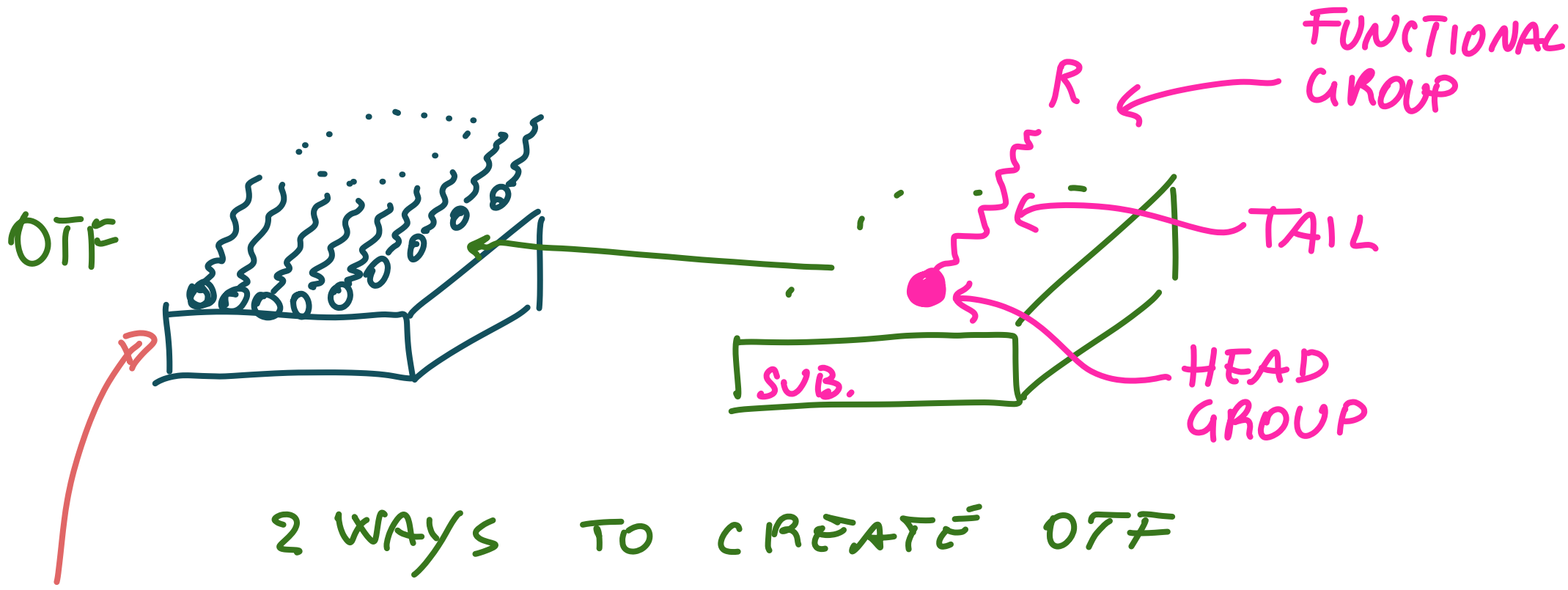
MOLECULAR FCN TECHNOLOGY

OBJECTIVES

1) THE BASIC MOLECULE - HOW TO SELECT
2) THE FCNTOL STRUCTURE & PARAMETERS
3) MOLECULAR DYNAMICS SIMULATIONS


– SINGLE MOL. EXPECTED FUNCTIONAL BEHAVIOR (MODELING)
– MOLECULES IN THE SYSTEMS FUNCTIONAL BEHAVIOR (MODELING)
SYNTHESIS FEASIBILITY AND YEALD
THE MOLECULE
FABRICATION – ORGANIC THIN FILMS – WIRINGS FOR MOL. BIASING
COMPUTATIONAL CHEMISTRY ANALYSIS
POSSIBILITY TO OBSERVE / MEASURE TESTABILITY

BRIEF SUMMARY ON ORGANIC THIN FILMS – OTF



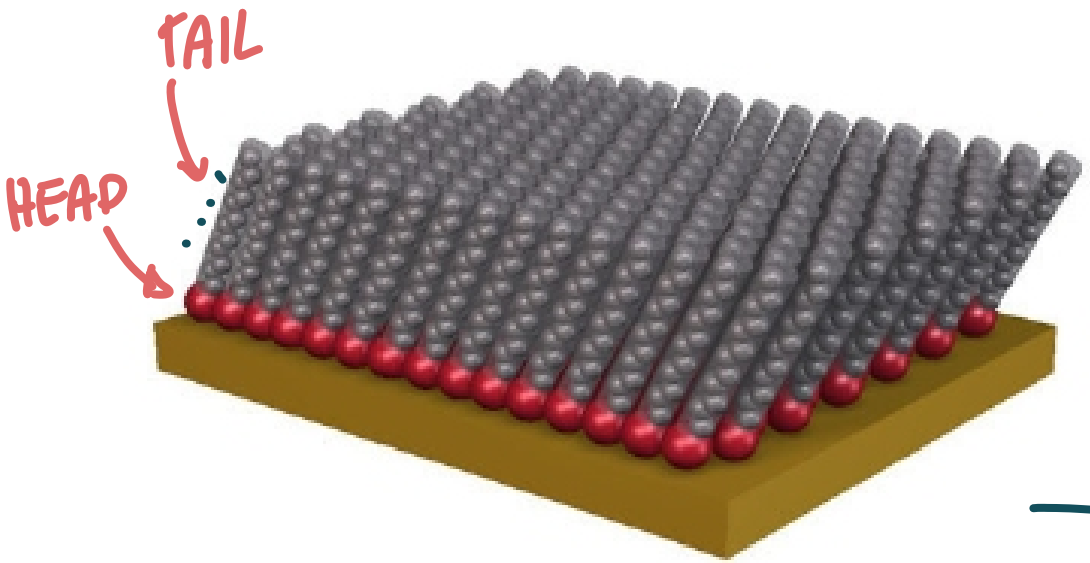
DENSE PACKED SELF ORGANIZED

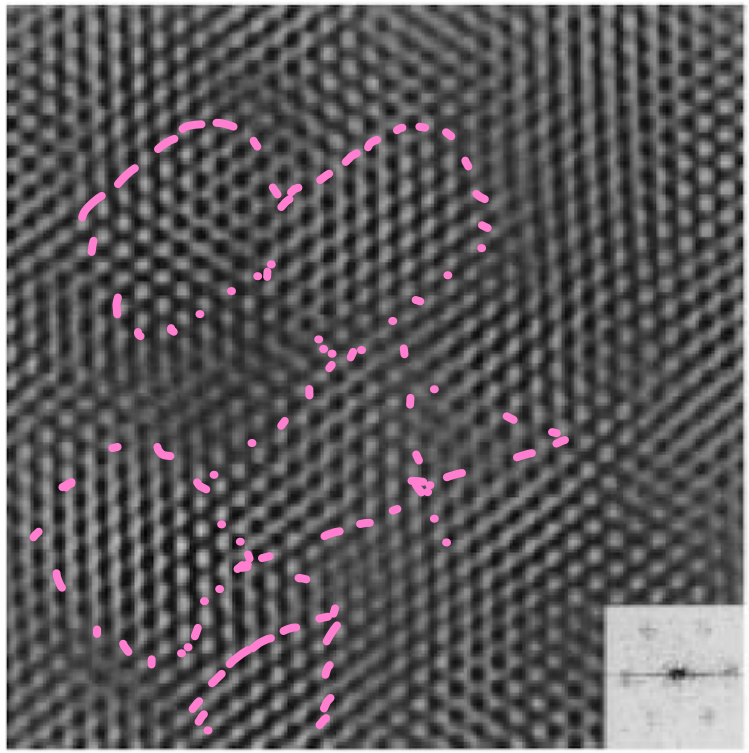
2 WAYS TO CREATE OTF

→ LANGMUIR LAYER

→ SELF-ASSEMBLY MONOLAYER - SAM

OTF EXAMPLE



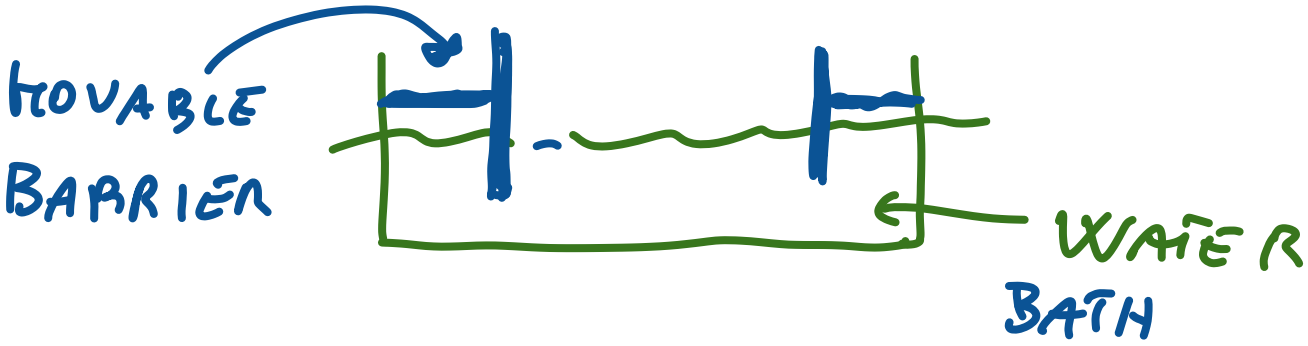


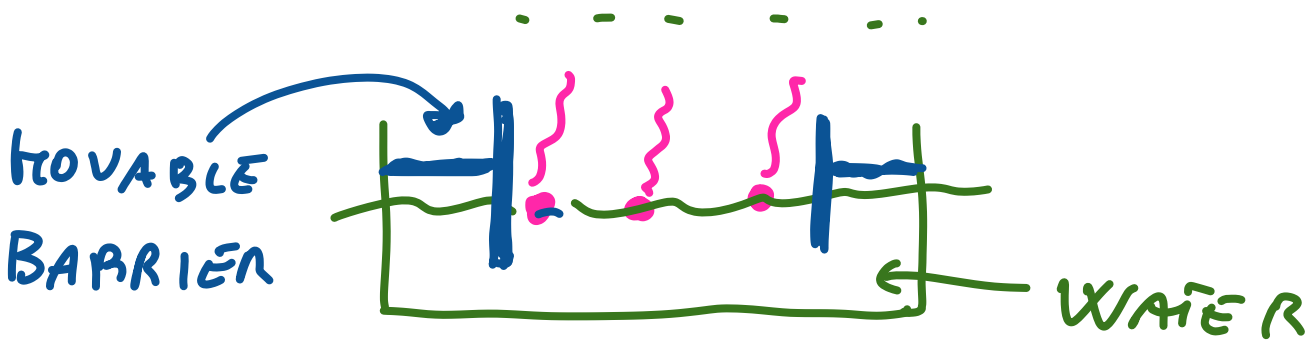
THIOL OTF - REGULAR ORIENTATION IN SUBZONES

LANGMUIR LAYER

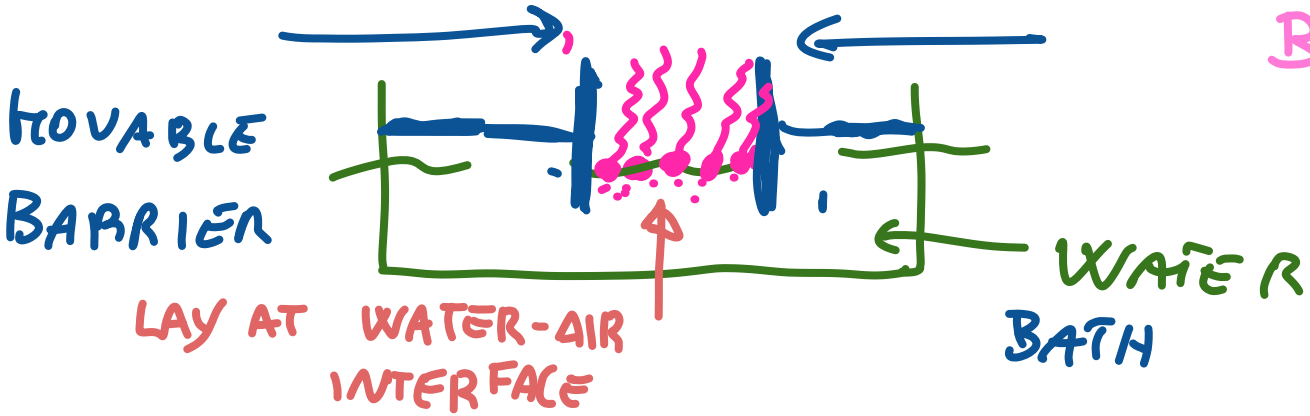
REGION
HYDROPHOBIC

HYDROPHILIC
REGION





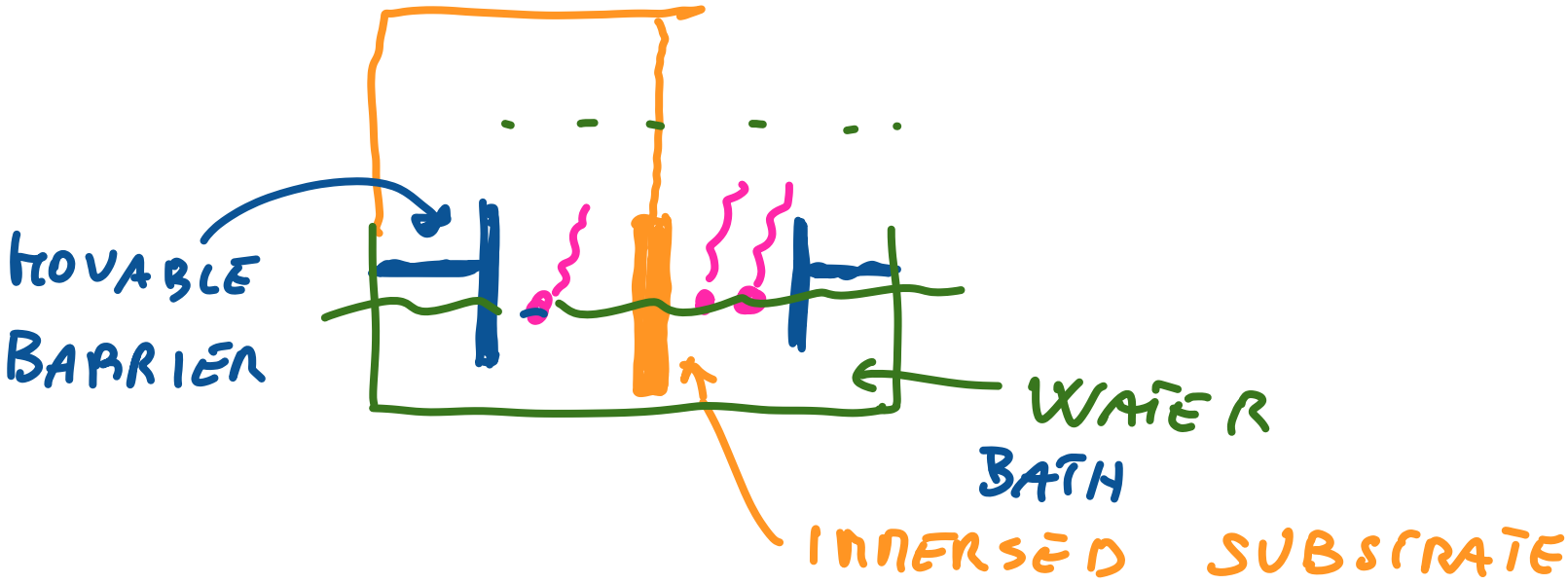
MOLECULES DEPOSITED
WITH A GIVEN
CONCENTRATION

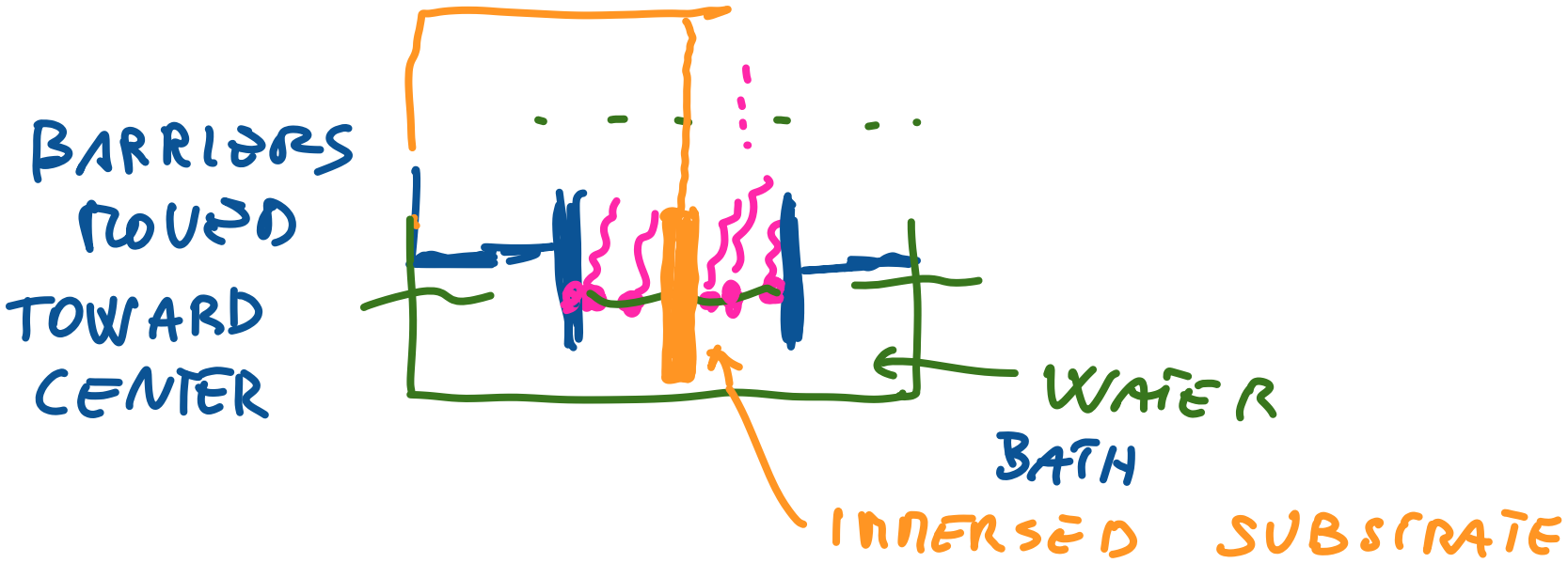


BARRIERS MOVED
TOWARD THE
CENTER

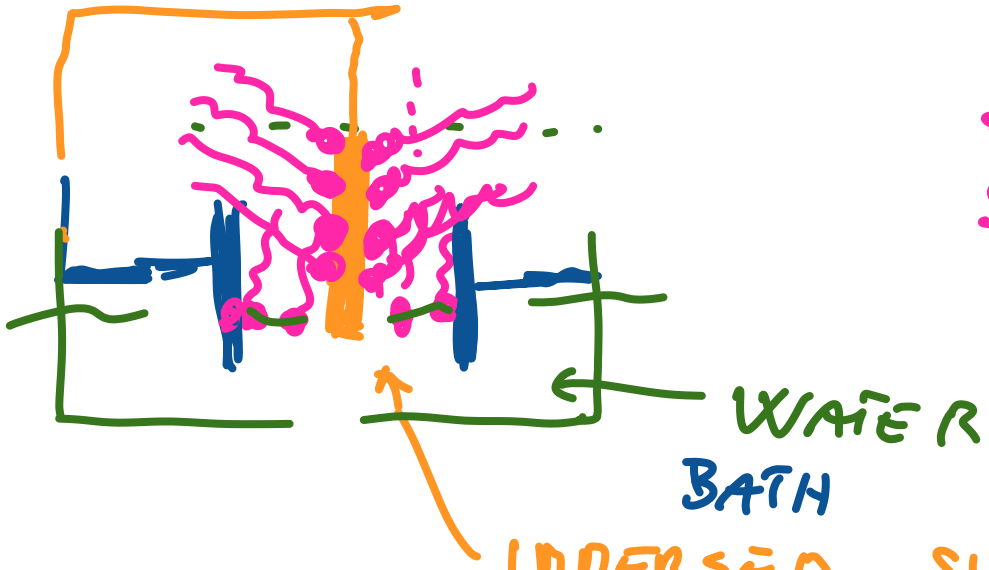
FILM CREATED

LANGMUIR - BLODGETT (LB)





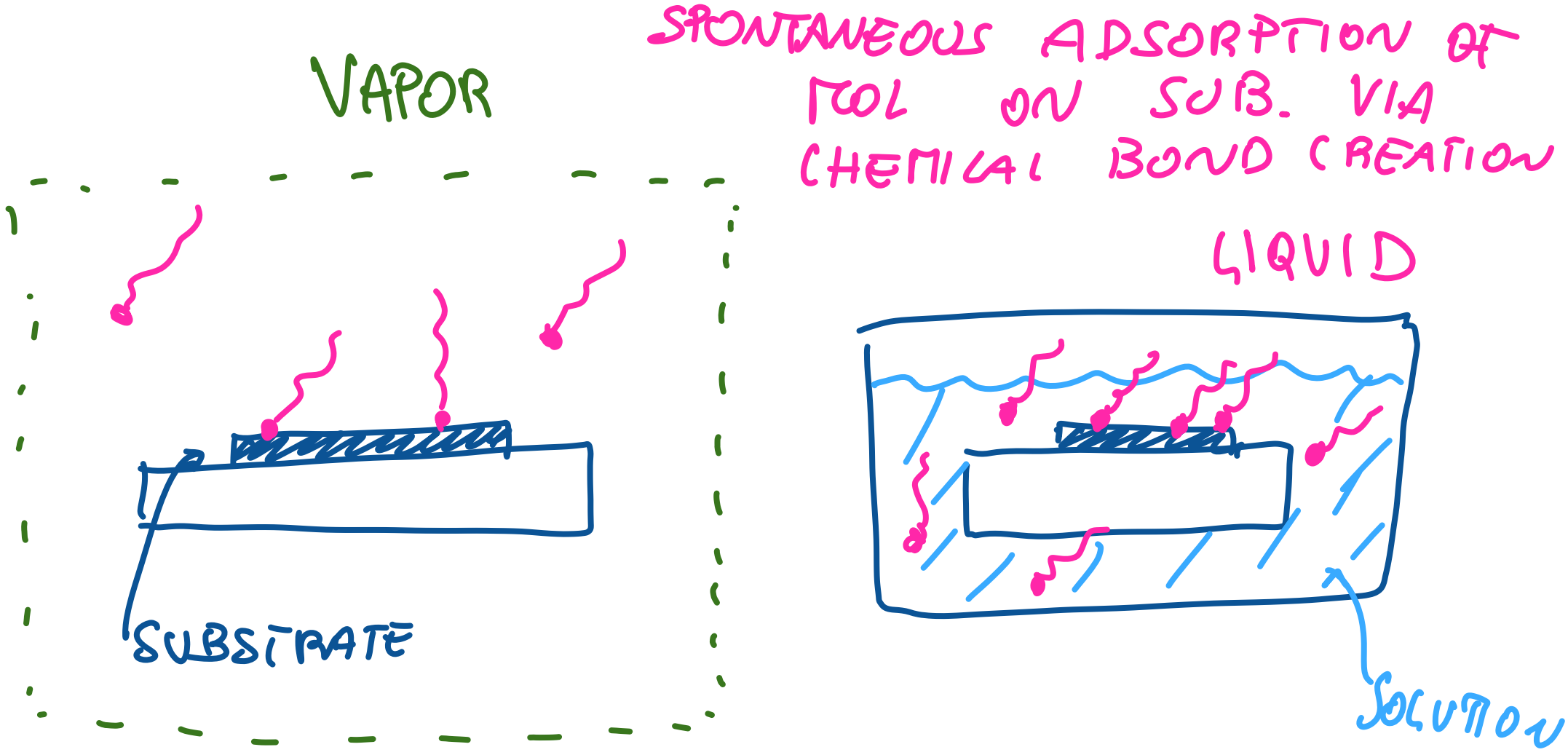
SUBSTRATE IS PULLED



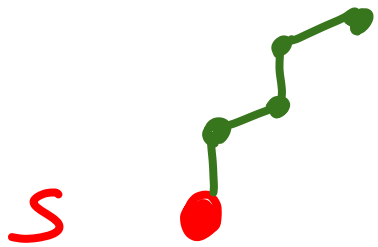
MOLECULES ATTACH IN A IN A REGULAR ORGANIZATION

THE PROCESS CAN BE ITERATED TO OBTAIN MULTICAYER LB FILMS

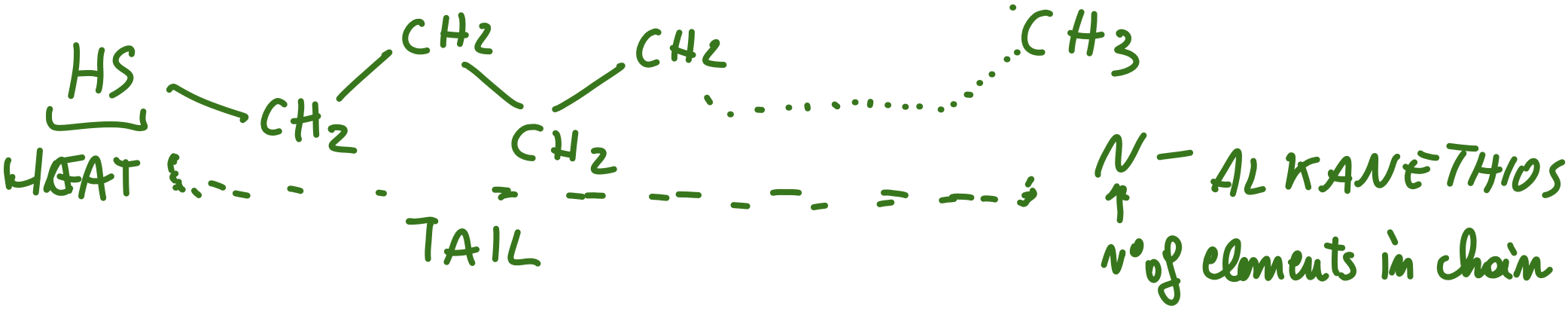
SAM - SELF ASSEMBLED MONOLAYERS

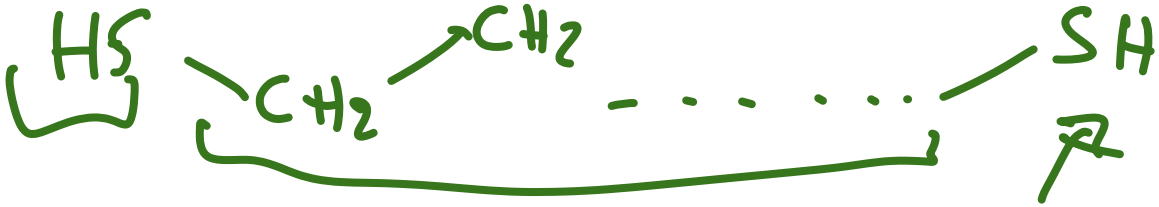


EXAMPLE: GOLD + SULFUR



THIOL -SH



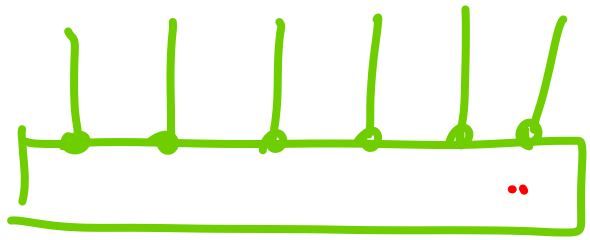


N - ALKANEDTHIOL

..... many others are possible and useful

FOR BISFERROCENE RECIPE 2 STEPS

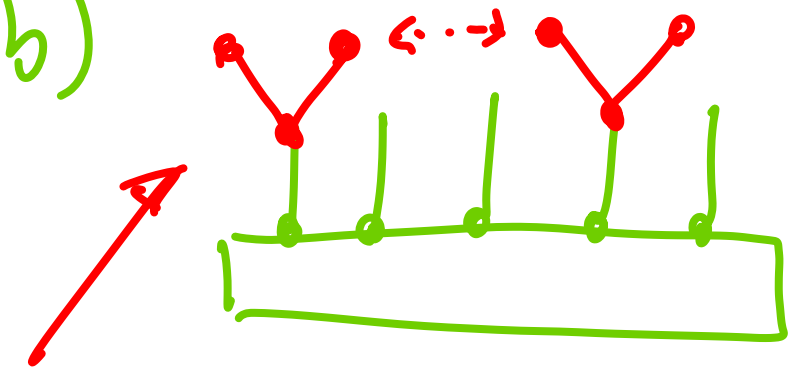
a)



SAM WITH THIOLS

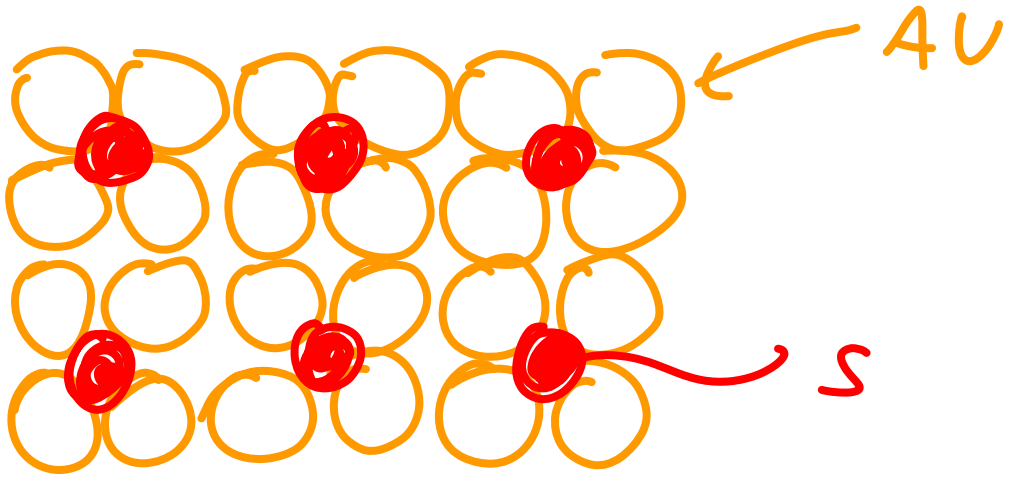
- PROPER CONCENTRATION
- // GOLD LATTICE ORIENTATION

b)



BISFERROCENE + THIOLS

HINDRANCE OF BISFERROCENES

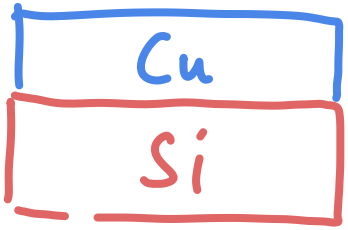


TYPICAL ATTACHMENT

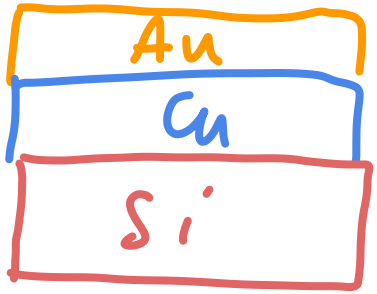
(TOP VIEW)

SIMULATION OF THE PROCESS USING MOLECULAR DYNAMICS (LAMMPS)

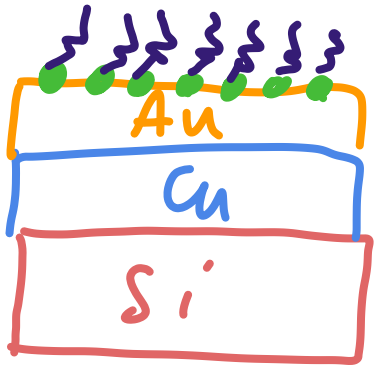
SUBSTRATE



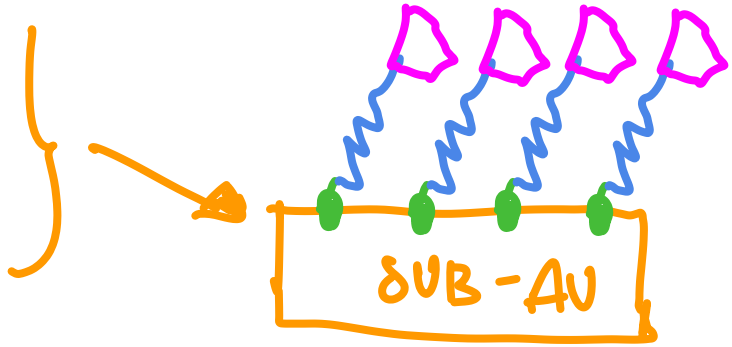
COPPER LAYER



GOLD



THIOLS

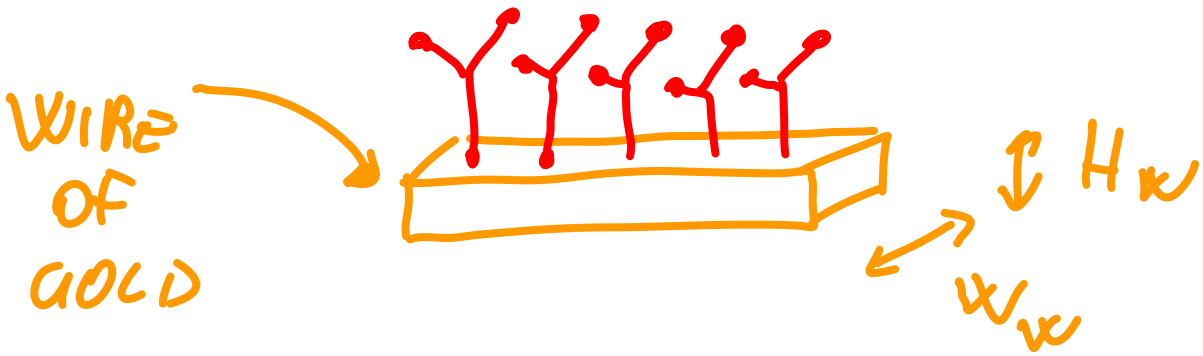


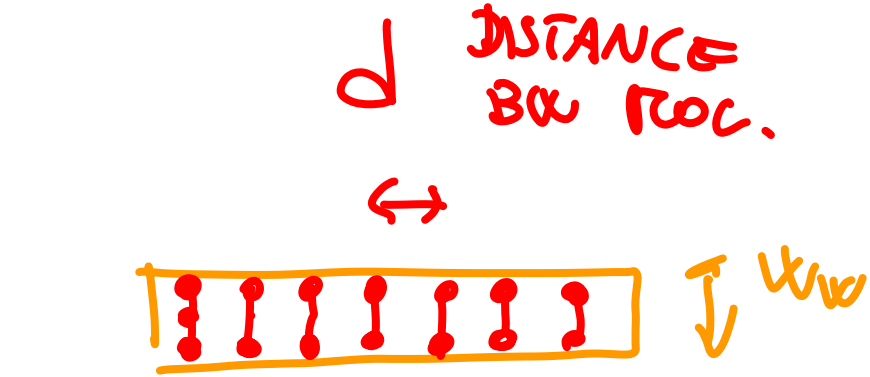
FERROCENYL - HEXANE THIOL

SINGLE FERROCENE + THIOL - COMMERCIAL THIOL.

2) THE MOL-FCN STRUCTURE

2.1) THE MOL-FCN WIRE (GUIDING WIRE)



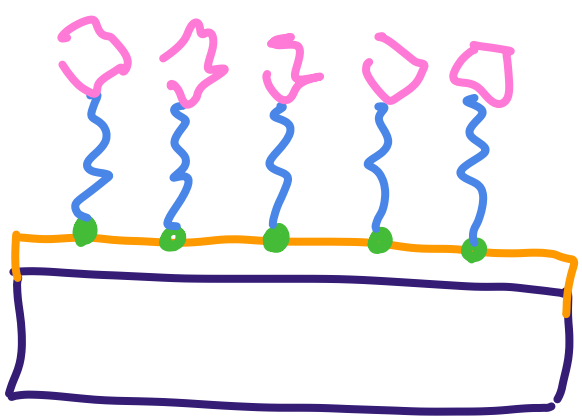


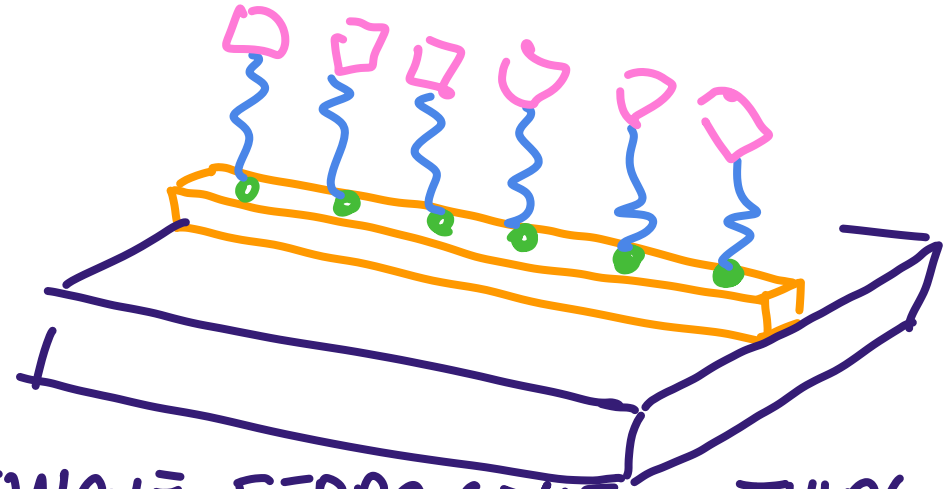
TOP VIEW

ORGANIZATION DEPENDS

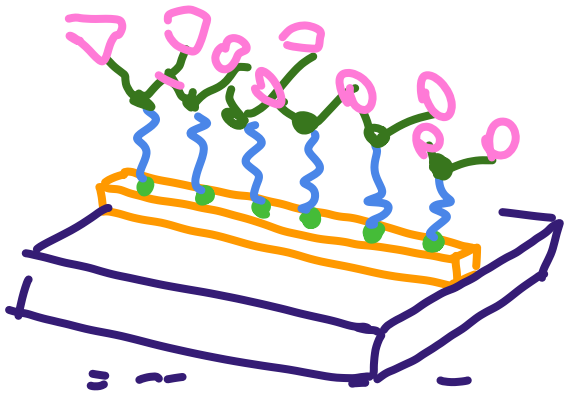
- → GOLD STR.
- → SH → ATTACHMENT
- → BISF. HINDRANCE

MOLECULAR DYNAMICS SIMULATION



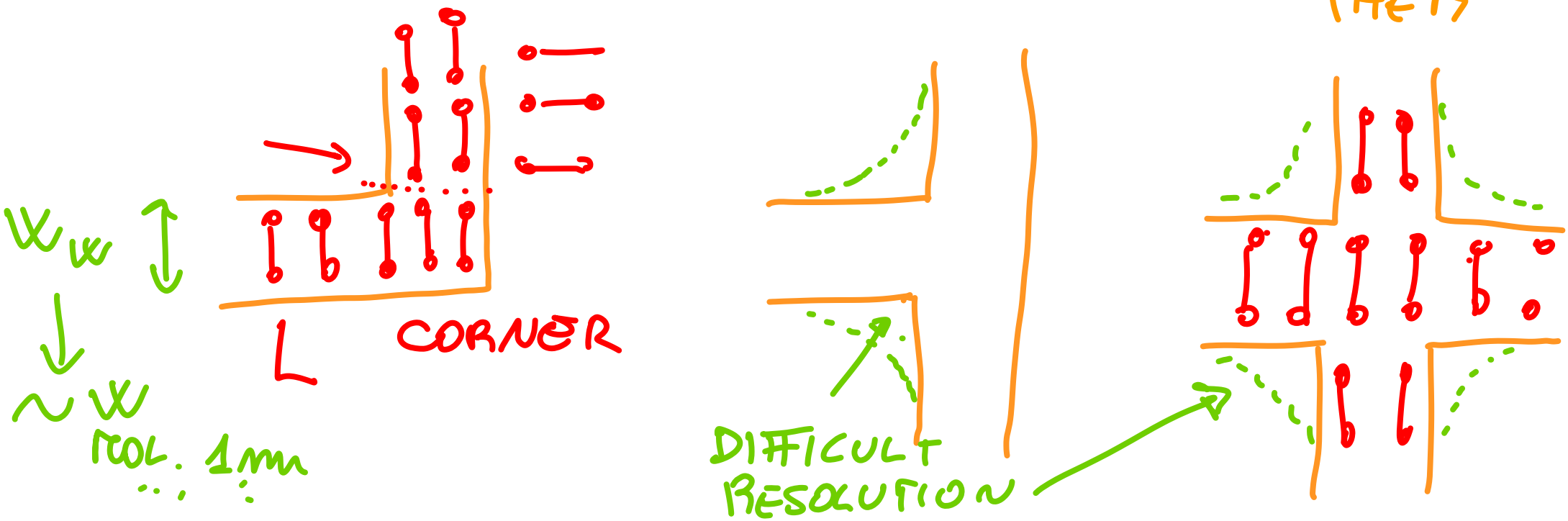


GOLD WIRE + SINGLE FERROCENE + THIOL



- OXIDIZED - NO VERTICAL CLOCK
- OXIDIZED + VERTICAL CLOCK
- BISFERROCENE-THIOLATED + V. CLOCK

2.2.) MORE COMPLEX PATTERNS & MOLECULES DEPOSITION ON THEM

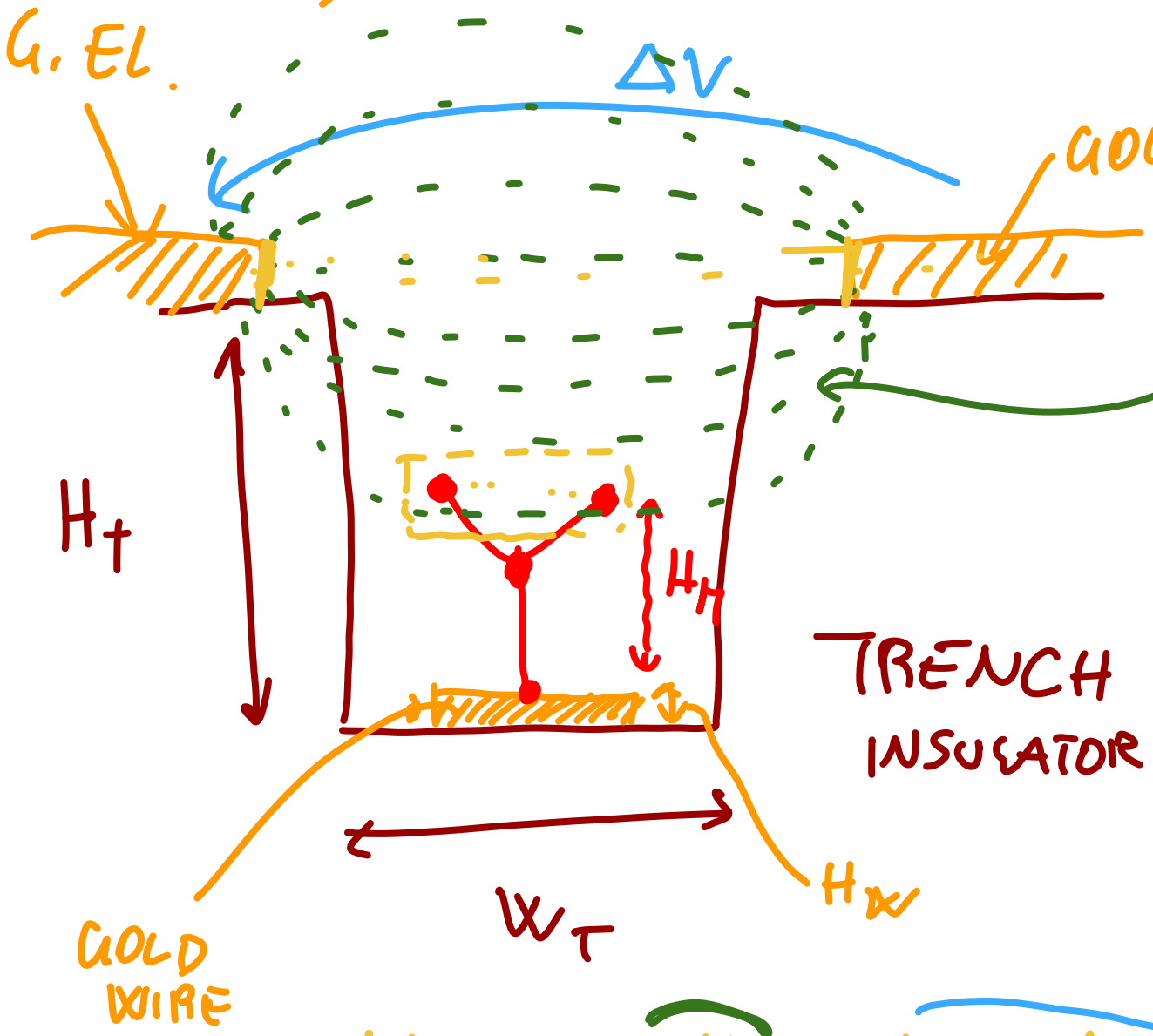


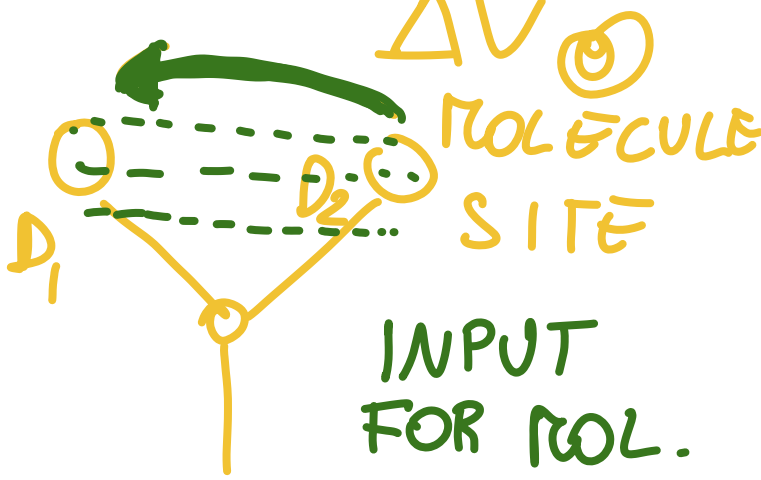
→ SIZE WIRE

→ CRISTAL ORG → SAM ON THE PATTERNED WIRE

→ DIFFICULT CONTROL OF RESOLUTION

2.3) INPUT / CLOCKING (external influence)

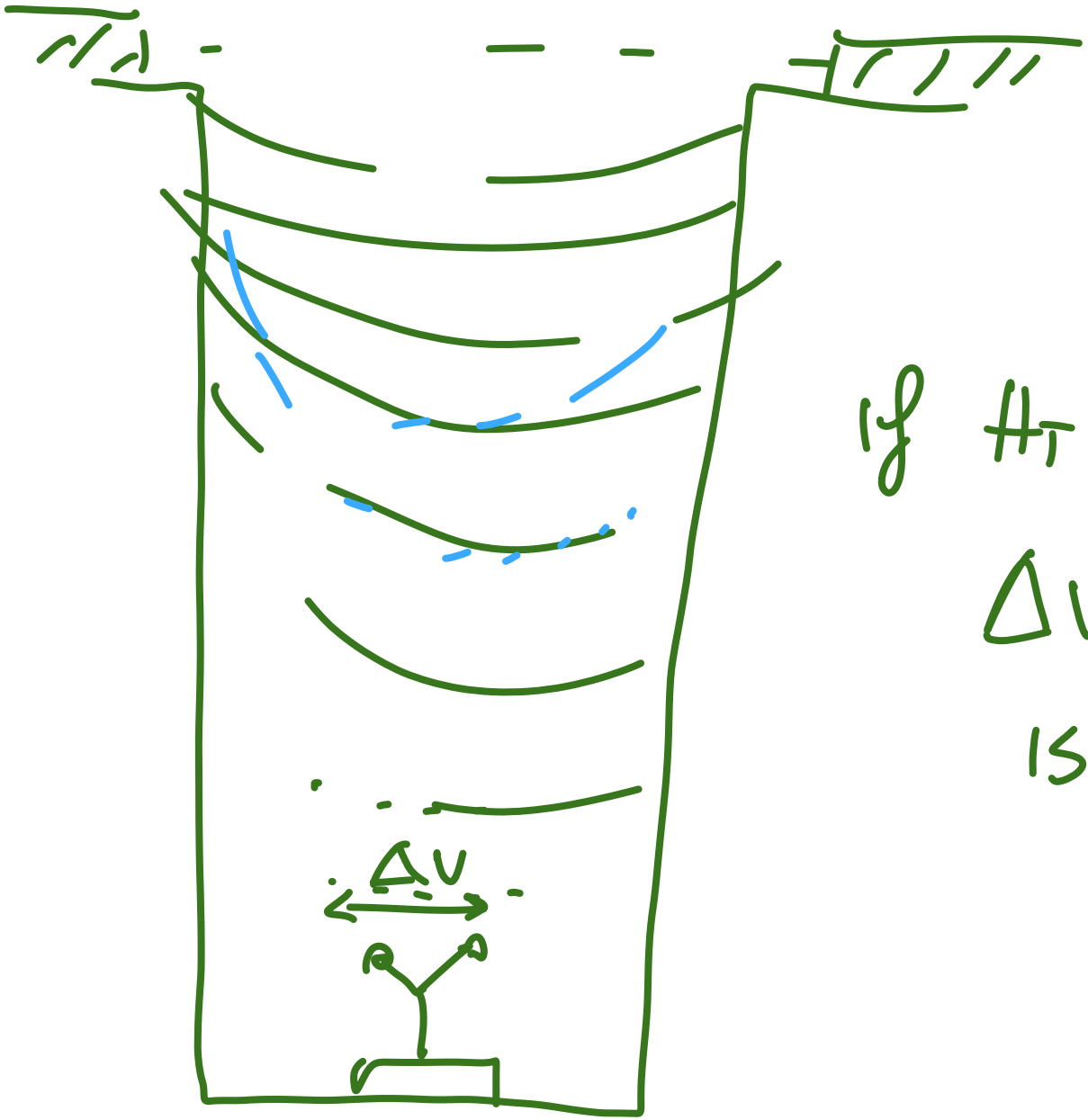




MAXIM. > H_T > $H_M + H_W$ ← CLOCKING

ΔV IS USEFUL @ MOL. SITE

$H_T < H_{T\,MAX}$! ΔV ACROSS D1-D2 SUFFICIENT FOR POLARIZATION

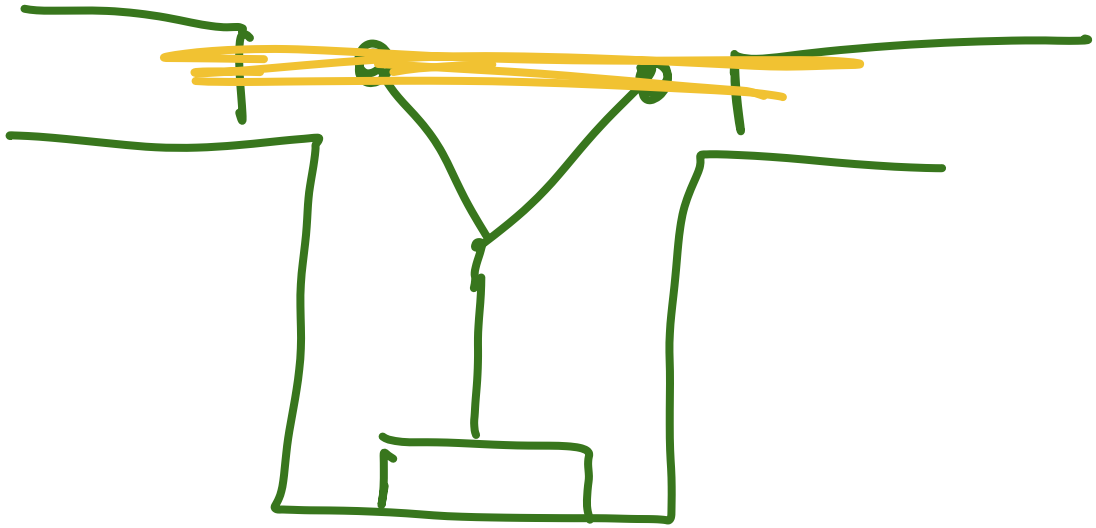


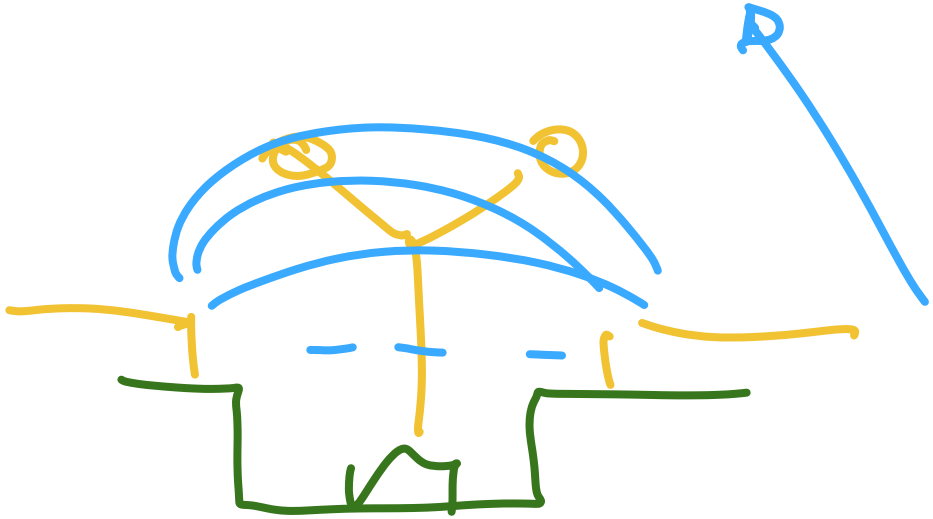
if H_T is too HIGH

ΔV @ TOL SITE

IS TOO SMALL

$H_T < H_{MIN}$: ELECTRODES USED FOR CLOCK →





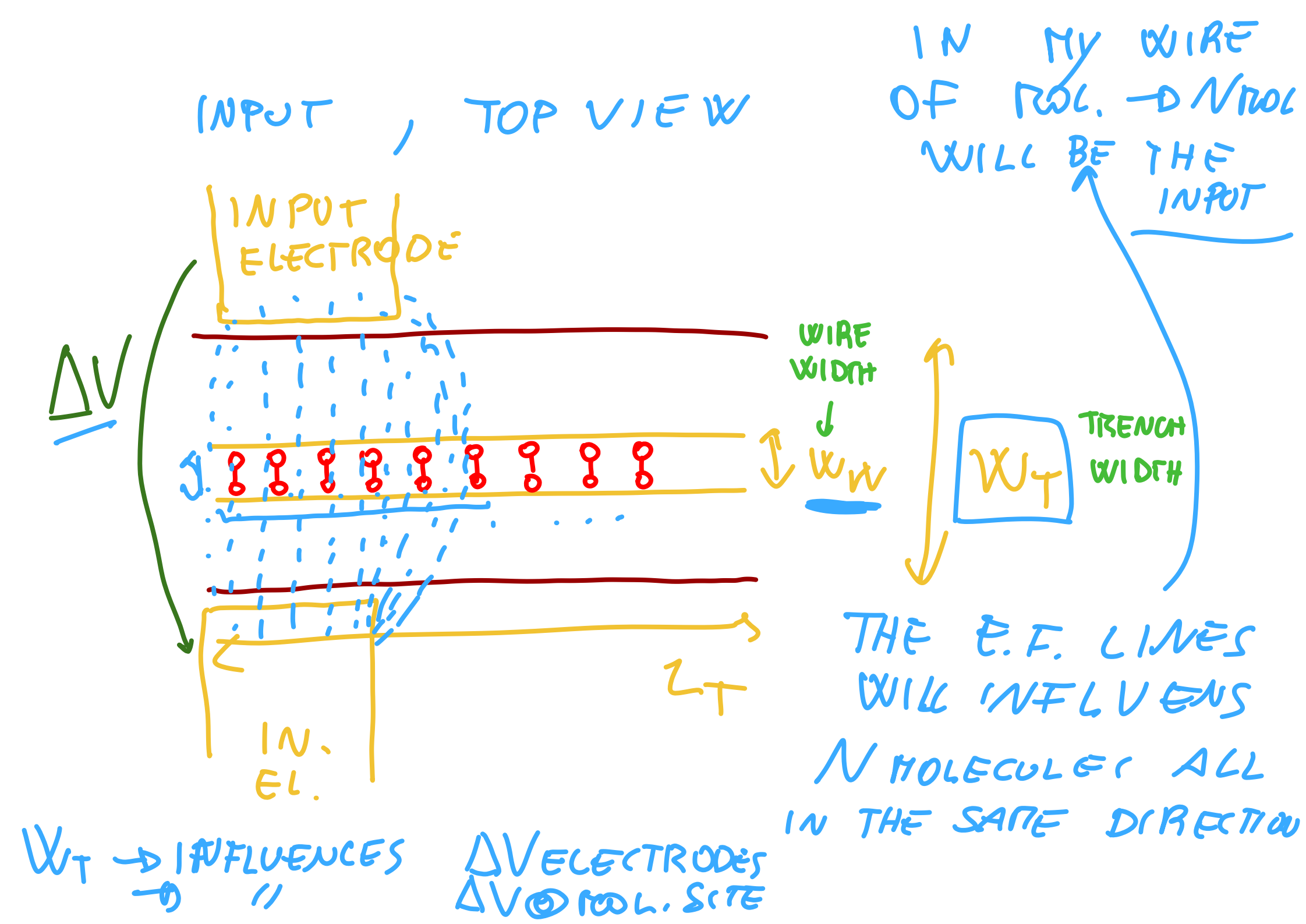
if H_T is SMALL

ΔV @ POL SITE

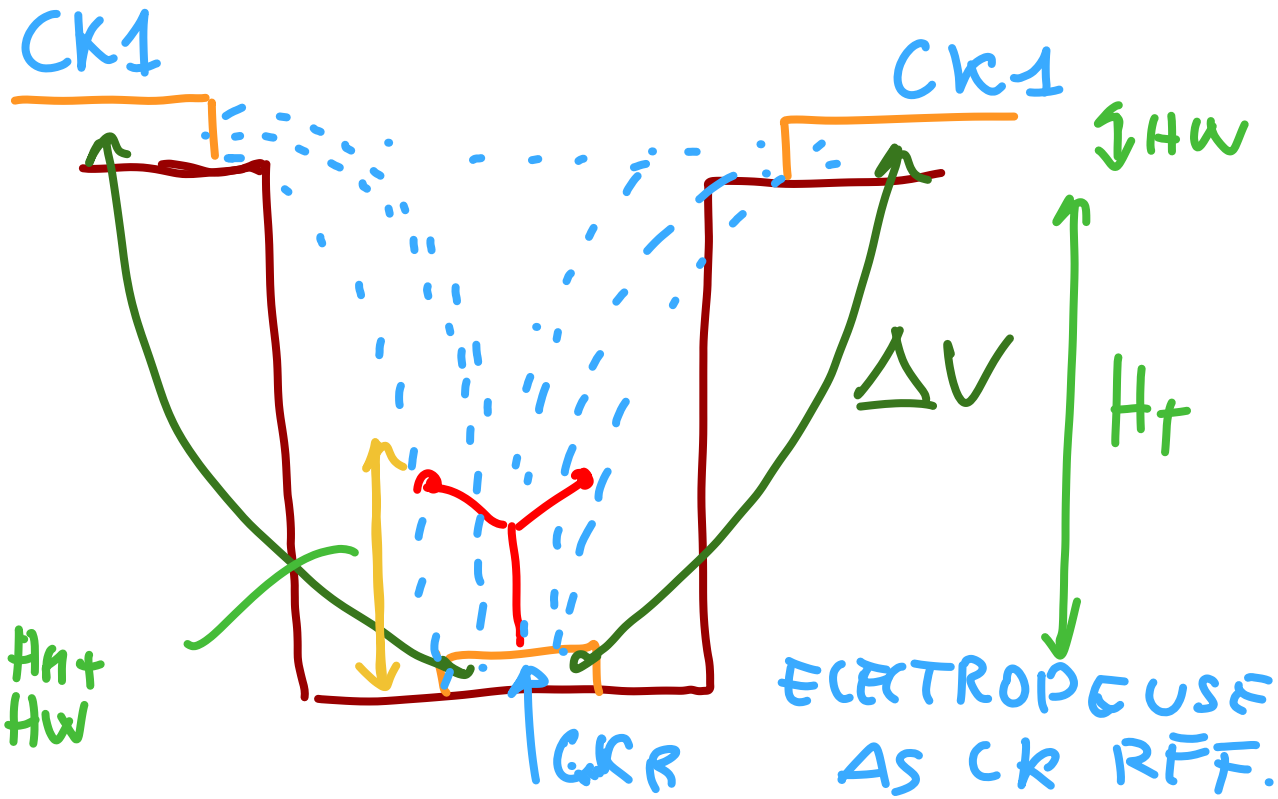
GOOD

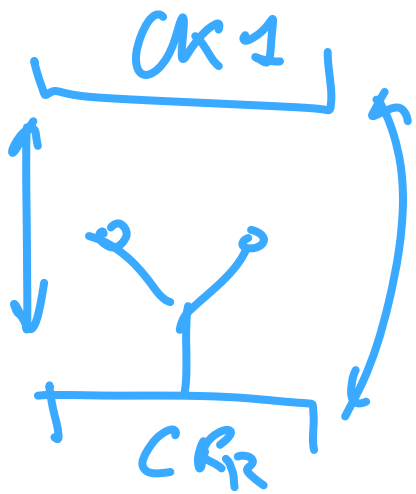
GOOD FOR INPUT

NOT GOOD FOR CK →


INPUT , TOP VIEW
IN MY WIRE OF MOL. → N MOL WILL BE THE INPUT
INPUT ELECTRODE
ΔV
WIRE WIDTH
W_W
W_T
TRENCH WIDTH
L_T
IN. EL.
THE E.F. LINES WILL INFLUENS N MOLECULES ALL IN THE SAME DIRECTION
W_T → INFLUENCES → // ΔV ELECTRODES
ΔV @ MOL. SITE

CLOCKING



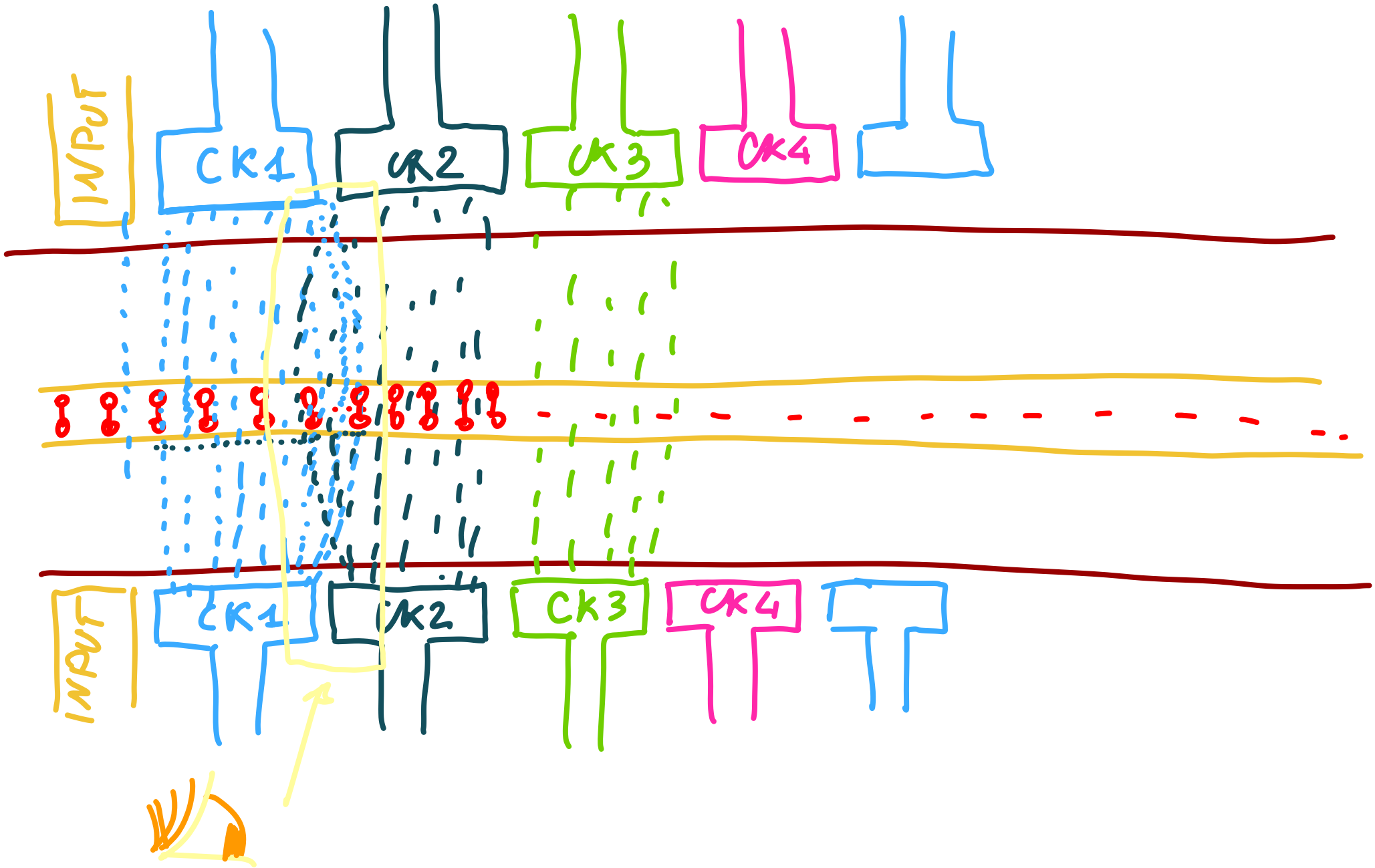


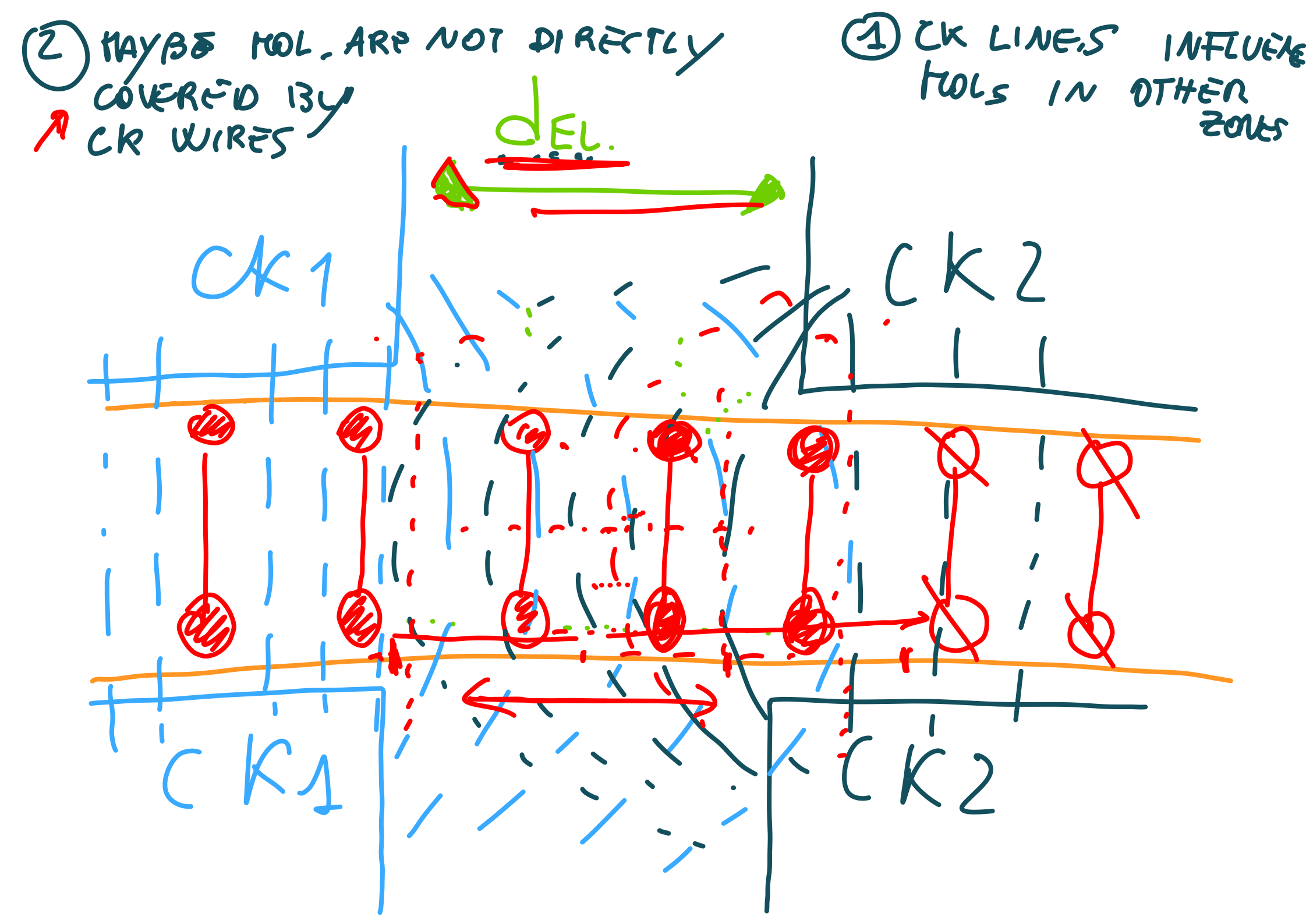
IDEAL CLOCK DISTRIBUTION VERY DIFICULT

IF H_T IS ENOUGH THE E.F. LINES @ TOOL SITE ARE VERTICAL, UNIFORM ⟶ CAN BE USED AS CK

$$H_T = \alpha (H_M + H_W)$$

TOP VIEW CLOCKING FOR PHASE ORGANIZATION




(2) MAYBE MOL. ARE NOT DIRECTLY COVERED BY CK WIRES
(1) CK LINES INFLUENCE MOLS IN OTHER ZONES
DEL.
CK1
CK2
CK1
CK2

THE PHASE SEQ.

CK1	CK2
NO CK	NO CK
CK APPLIED	NO CK
CK APPLIE	APPLIED

(2) CK1 + CK2 ON CREATE CONSTRUCTIVE INTERFERENCE

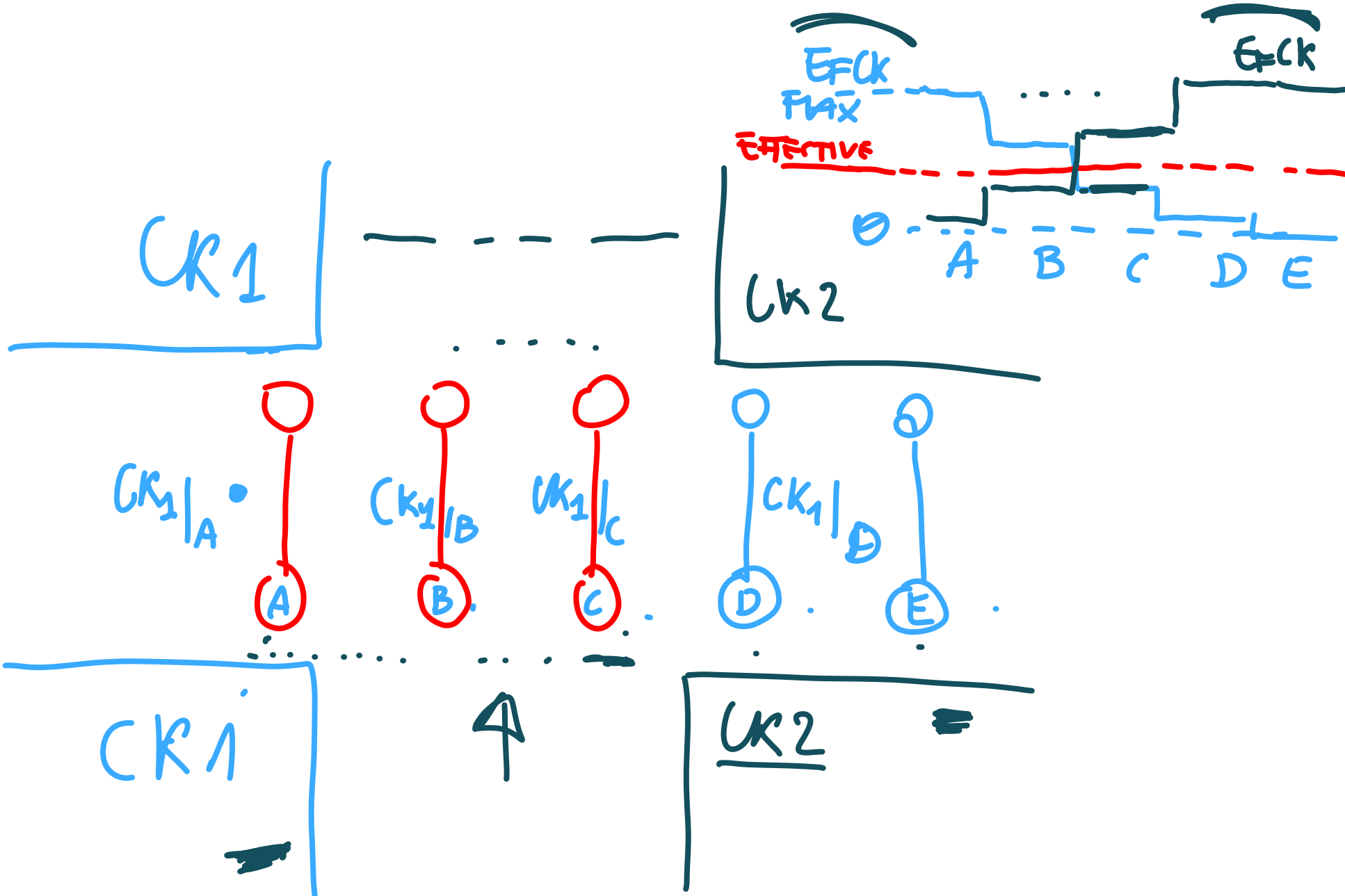
ALSO TOL. BW ELE. ARE INFLUENCED

→ depl. < MAXd : CONSTR. INT. TRUE

(1) NOT A REAL PROBLEM IN WIRE

→ INFO PROPAGATES IN A WAVE

THE LIMIT OF INFO IS NOT CORRESPONDENT TO GEOMETRICAL LIMIT OF CK. ELECTRODE


EFCK
FMAX
EFFECTIVE
EFCK
A
B
C
D
E
CK1
CK2
CK1|A
CK1|B
CK1|C
CK1|D
A
B
C
D
E
CK1
4
CK2

PROCESS VARIATIONS - PARAMETERS

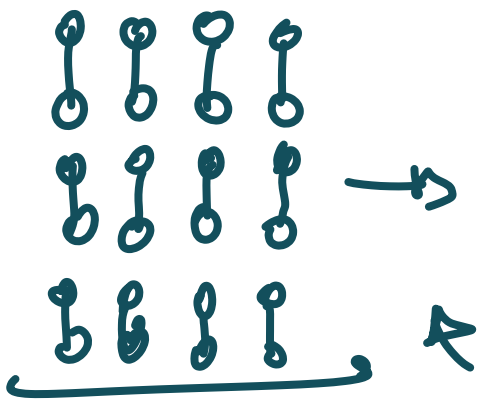
PARAMETERS FROM TECH.

- MOLECULE: → SYNTHESIS
  - → SIZES NOW UNIFORM
  - → 1 DOT MISSING
  - → 1-2 ATOMS MISSING

- SAM: - REGIONS FORMED, NOT NECESSARILY REGULAL IN ALL THE PATTERNED STRUCTURE

BUS OF MOL — SUBSTRATE

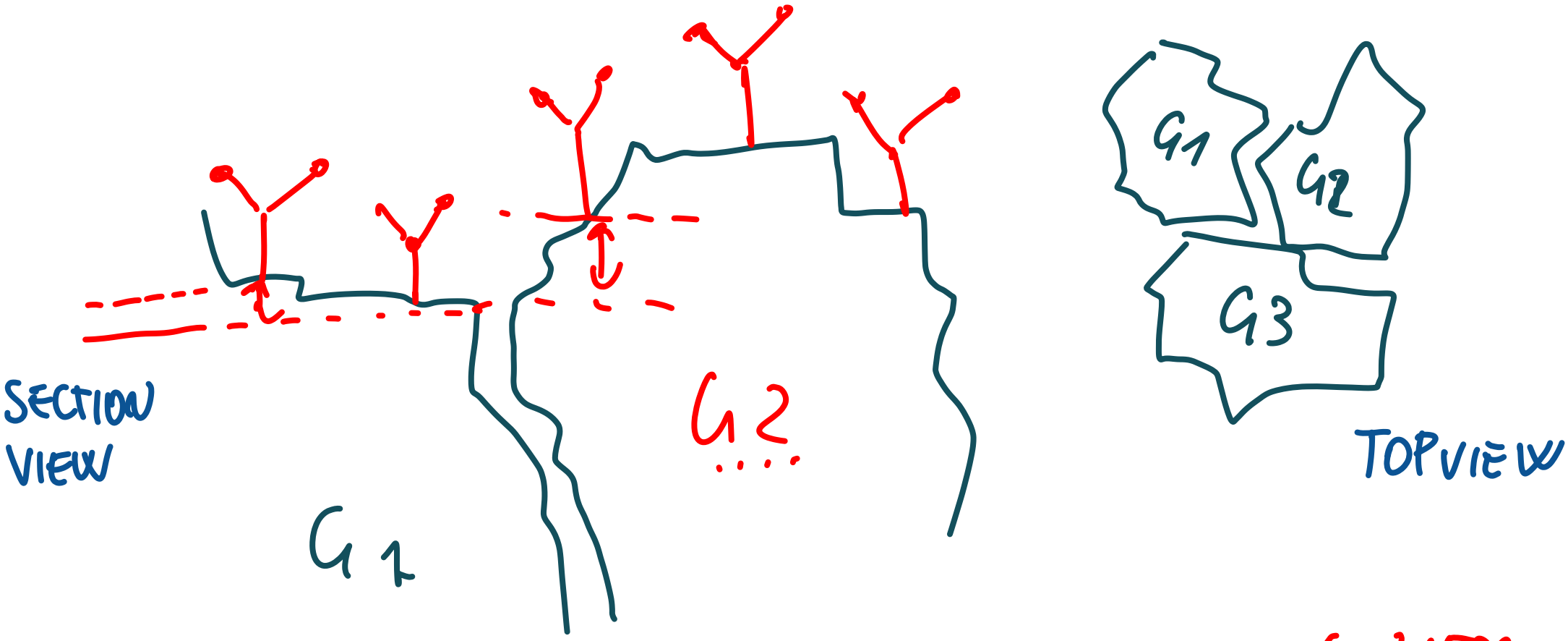
→ W WIRE → NOT REGULAR



→ IMPORTANT TO MANAGE WIRES BIGGER SINGLE MOL

↑ NUMBER OF 3 MOL : EXAMPLE

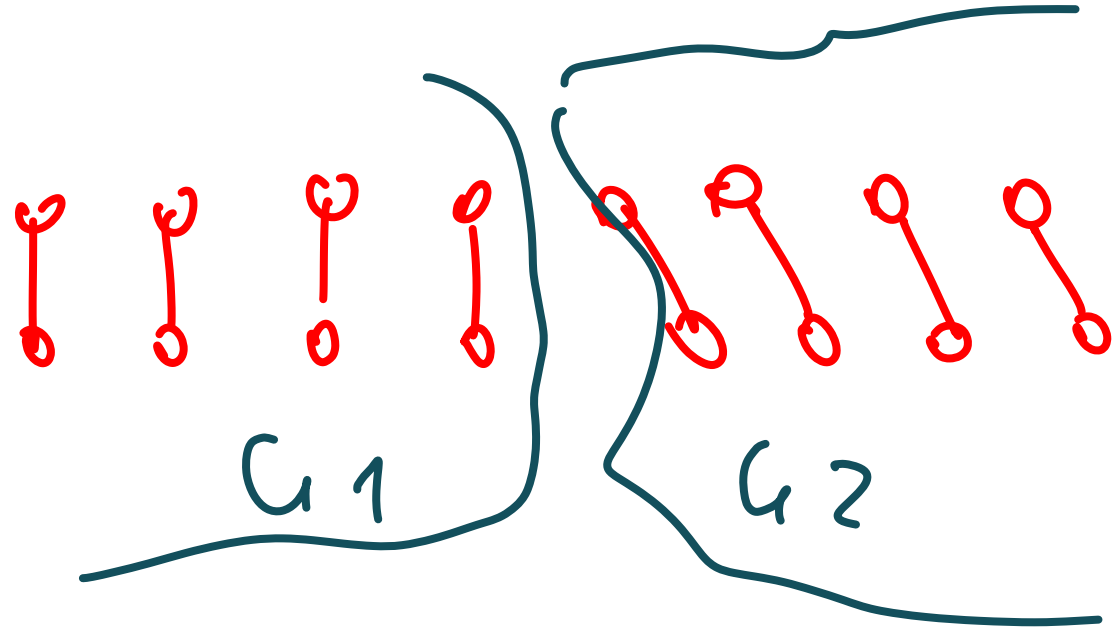
GUIDING WIRE CRISTAL STRUCTURE - PARAMETERS



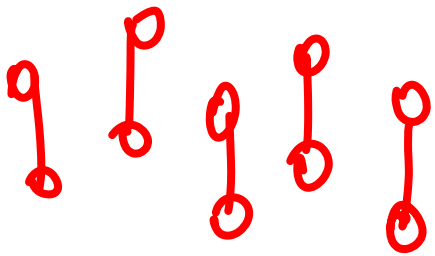
- DIFFERENT H. WITHIN EACH GRAIN (INTRA GRAIN)

(VERTICAL DISPLACEMENT OF ROI.)

- ALONG GRAINS (INTER GRAINS)

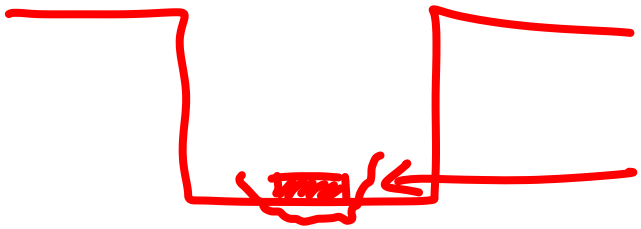


TILT DUE TO GRAIN ORIENTATION



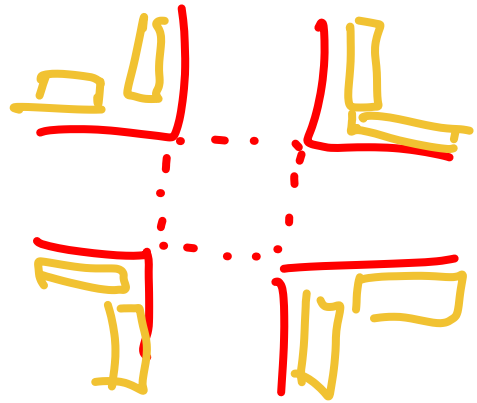
SHIFT DUE TO ANCHORING POINTS NOT IDEAL

- TRENCH PARAMETERS . H_T, W_T



- ELECTRODE PARAMETERS – DISTANCE BW-ECECTRON.

↳ HOW TO DEAL WITH CORNERS



CRISTALLIZATION

1) STRUCTURE IDENTIFIED

2) PARAMETERS ENTANGLED
BW TECH - DEVICE - FUNCTIONALITY

3) MOLECULAR DYNAMICS SIMULATION
FOUNDAMENTAL TO STUDY AND
GUIDE THE FABRICATION PROCESS

→ THE TREND IN FUTURE NANOELECTRONICS