

## Supporting Information

### Electric Field-Enhanced Adsorption of Chiral Molecules on Ferromagnetic Substrates

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#### **Materials.**

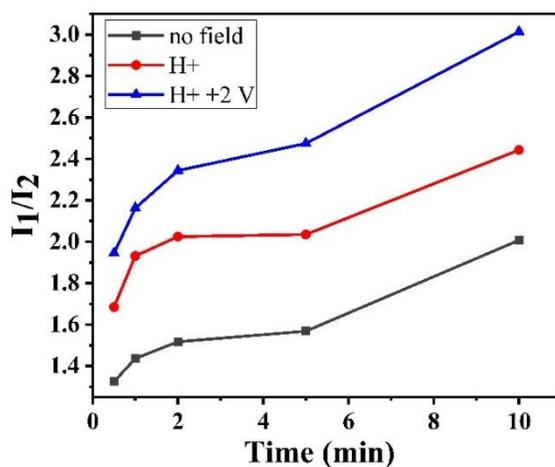
Silicon wafers were purchased from Vin Karola Instruments, USA (crystal orientation  $\langle 100 \rangle$ , thickness  $525 \pm 25 \mu\text{m}$ , As-doped). Oligopeptide molecules were purchased from Hy Laboratories, Ltd (Israel). DNA molecules were purchased from IDT Syntezza Biosciences. The absolute ethanol was purchased from Gadot (Israel). Trifluoroethanol was purchased from Sigma Aldrich. The water used in the experiments was purified using a Millipore Synergy® Water Purification System ( $18.2 \text{ M}\Omega/\text{cm}$  at  $25 \text{ }^\circ\text{C}$ ). The metals used in the ferromagnetic surface preparation were purchased from Mark Technologies (Israel). The Micro Bio-Spin P-30 column was purchased from Bio Rad.

#### **PMIRRAS:**

Infrared spectra measured for the oligopeptides were carried out in polarization modulation–infrared reflection–absorption mode, PM–IRRAS, using a Nicolet 6700 FTIR equipped with a PEM-90 photoelastic modulator (Hinds Instruments, Hillsboro, OR). Each of the spectra were collected by accumulating 500 scans and the samples were mounted at a Brewster angle of incidence of  $80^\circ$ .

### Kinetics of adsorption of L-COOH:

In order to monitor the kinetics of adsorption, the formation of L-COOH oligopeptide SAM on the gold-coated Ni substrates were monitored by PMIRRAS. Different adsorption durations were measured for different matrices. Here in **Fig. S1**, the comparison is shown for three cases: (i) no field applied, (ii) the substrate was magnetized with its magnetic north pole up (H+), and (iii) the substrate was magnetized with its magnetic north pole up and +400 V/m (H+, +2 V) was applied on the substrate. The choice of the direction of the magnetic and electric field was made from the results obtained for the adsorption of L-COOH on Ni/Au. An increase in the adsorption intensity ratio of the amide I and amide II peak in the IR spectra is clearly seen, going from the SAM, grown under no magnetic field, to the SAM grown under the H+ field, with the highest being the SAM grown under both the magnetic and electric field.

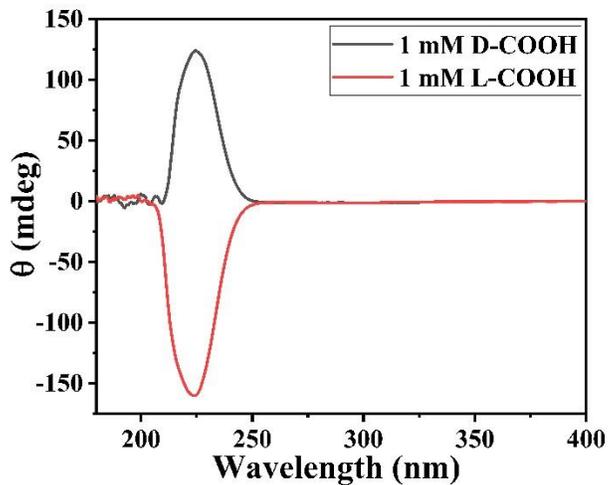


**Fig. S1:** The plot shows a comparison of the adsorption intensity of L-COOH SAMs incubated for different times under the following conditions: Black line - No field applied on the ferromagnetic substrate, Red line – the ferromagnetic surface is magnetized up (H+), Blue line – the ferromagnetic surface is magnetized up and a +2 V field was applied on it (H+, +2 V).

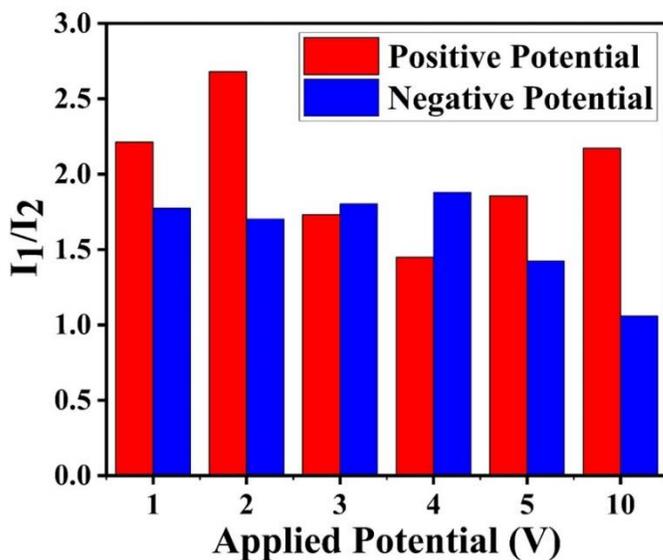
### Circular Dichroism Spectra of D and L-COOH:

The CD spectra of pure oligopeptides were measured in a 1 cm path length cuvette with 1 mM oligopeptide dissolved in pure ethanol at 20 °C on a JASCO J-715 spectrometer equipped with a thermoelectrically controlled single cell holder. In the spectra (**Fig. S2**), the L-COOH

oligopeptide shows a negative peak at 223 nm, whereas the D-COOH oligopeptide shows a positive peak at around the same wavelength.



**Fig. S2:** Circular dichroism spectra of 1 mM D- and L-COOH oligopeptide in ethanol



**Figure S3:** Normalized intensity ratio ( $I_1/I_2$ ) of the amide-I ( $-1670\text{ cm}^{-1}$ ) and amide-II ( $-1540\text{ cm}^{-1}$ ) peak of L-COOH for the different voltage applied keeping the ferromagnetic surface magnetized up ( $H^+$ ). The results with positive and negative voltage are presented by RED and BLUE colors respectively.

**Table S1:** Mean and standard deviation data for adsorption of D-COOH on Ni/Au in PMIRRAS

(3 samples were studied for each condition)

<b>D-COOH</b>	<b>H+</b>		<b>H-</b>	
	<b>Mean</b>	<b>Standard Deviation</b>	<b>Mean</b>	<b>Standard Deviation</b>
<b>-2 V</b>	0.49	0.15	0.79	0.14
<b>0</b>	0.74	0.20	<b>1</b>	5.6 E-7
<b>+2 V</b>	0.92	0.03	1.1	0.074

**Table S2:** Mean and standard deviation data for the adsorption of L-COOH on Ni/Au in PMIRRAS

(3 samples were studied for each condition)

<b>L-COOH</b>	<b>H+</b>		<b>H-</b>	
	<b>Mean</b>	<b>Standard Deviation</b>	<b>Mean</b>	<b>Standard Deviation</b>
<b>-2 V</b>	0.78	0.13	0.89	0.033
<b>0</b>	1	5.6E-7	0.82	0.054
<b>+2 V</b>	1.13	0.20	1.1	0.12

**Table S3:** Adsorption of L-NH<sub>2</sub> on Ni/Au in PMIRRAS

<b>L-NH<sub>2</sub></b>	<b>H+</b>	<b>H-</b>
<b>-2 V</b>	1.0	0.87
<b>0 V</b>	1	0.97
<b>+2 V</b>	0.86	0.92

**Table S4:** Cathodic potential of a DNA adsorbed ferromagnetic surface under different combinations of magnetic and electric fields (3 samples were studied for each condition)

<b>dsDNA</b>	<b>Mean</b>	<b>Standard Deviation</b>
<b>H+, +2 V</b>	-0.052	0.0047
<b>H-, +2 V</b>	-0.036	0.0012
<b>H+, -2 V</b>	-0.10	0.0040
<b>H-, -2 V</b>	-0.17	0.0064

### *DNA adsorption*

The reduction of the monolayer was measured at the following condition.

Scan rate = 100mV/s

Range of reduction potential = -0.1 V to -1 V

Area of reduction peak (A) =  $\int_{E_1}^{E_2} I \cdot dE$

Total charge (Q) =  $\frac{A}{v_b}$  ( $v_b$  is scan rate)

Charge per unit area ( $\rho$ ) = Q/ surface area

Number of protons transferred in the process per unit area = number of DNA molecules per unit of surface =  $\rho / (\text{charge of an electron})$

**Table S5**

Conditions	Area under the peak (A)	Charge per unit area ( $\rho$ ) = (Area under the peak) / (scan rate* surface area)	Number of proton transferred= $\rho /$ (charge of an electron)
H+, +2 V	0.015 mA.V	$4.8 \times 10^{-5} \text{ C. cm}^{-2}$	$3.0 \pm 0.4 \times 10^{14}$
H-, +2V	0.014 mA.V	$4.5 \times 10^{-5} \text{ C. cm}^{-2}$	$2.8 \pm 0.4 \times 10^{14}$
H+, -2 V	0.014 mA.V	$4.5 \times 10^{-5} \text{ C. cm}^{-2}$	$2.8 \pm 0.4 \times 10^{14}$
H-, -2 V	0.022 mA.V	$7.0 \times 10^{-5} \text{ C. cm}^{-2}$	$4.4 \pm 0.4 \times 10^{14}$