EE236: Experiment No. 7
MOS Capacitor C-V Characteristics

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1 Overview of the experiment

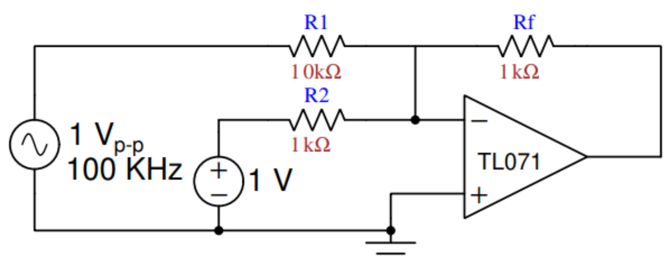
1.1 Aim of the experiment

The aim of the experiment is to measure the C-V characteristics of a given MOSCAP sample, and to obtain its material characteristics.

2 Lab Experiment

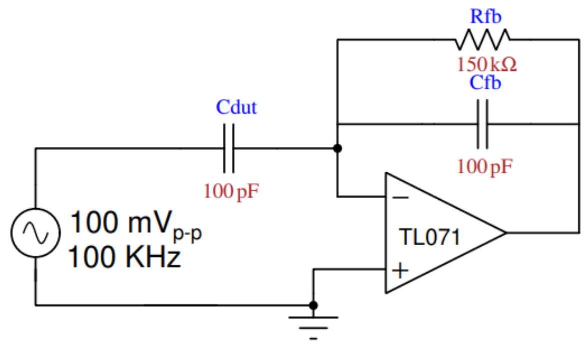
2.1 Circuits Used

2.1.1 Summer Circuit



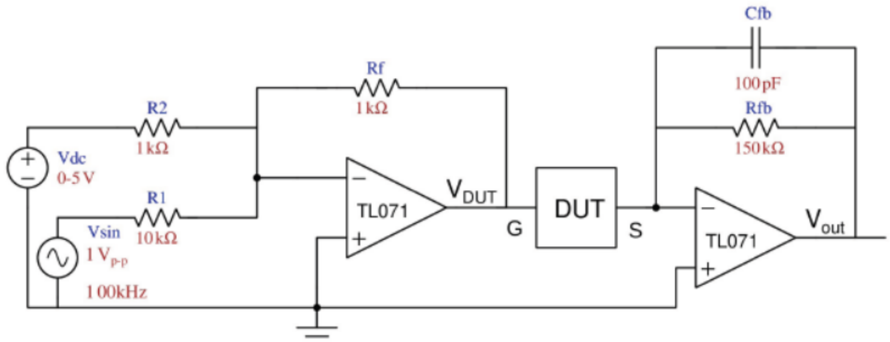
This is an inverting summer circuit. The output of this circuit is ideally:
$V_{OUT} = -(V_{dc} + V_{ac}\frac{Rf}{R1})$

2.1.2 Amplifier Circuit



This is an inverting amplifier circuit. The output of this circuit is a roll of decibel function dependent on C_{dut}, R_{fb} and C_{fb}.
A decrease in frequency results in the circuit not able to charge and discharge the capacitors under the specified cutoff time required. Thus the output waveform begins to distort and looses amplitude.

2.1.3 Experimental Setup to Obtain C-V Characteristics



From this configuration, we measure the AC gain from V_{DUT} to V_{out}. Theoretically, we know it is somewhat proportional to C_{DUT}. Thus we obtained the C-V characteristics, and further parameters are calculated.

3 Results

3.1 Summer Circuit

Output amplitude observed ranged from 107mV to 108mV when an input of 1 Vdc and a sinusoidal signal of 1Vpp of 100kHz is applied as expected

3.2 Readings Obtained for C-V Characteristics

V_{DC} (mV)	V_{dut} (mV)	V_{out} (mV)	Gain	C_{dut} (nF)
-5	108	260	2.407407407	20.0617284
-4.5	108	260	2.407407407	20.0617284
-4	108	280	2.592592593	21.60493827
-3.5	108	280	2.592592593	21.60493827
-3	108	300	2.777777778	23.14814815
-2.5	108	300	2.777777778	23.14814815
-2	108	320	2.962962963	24.69135802
-1.5	108	360	3.333333333	27.77777778
-1	108	400	3.703703704	30.86419753
-0.5	108	480	4.444444444	37.03703704
-0.2	108	500	4.62962963	38.58024691
0	108	500	4.62962963	38.58024691
0.3	108	520	4.814814815	40.12345679
0.5	108	560	5.185185185	43.20987654
0.8	108	640	5.925925926	49.38271605
1	108	760	7.037037037	58.64197531
1.2	108	900	8.333333333	69.44444444
1.5	108	1020	9.444444444	78.7037037
2	108	1080	10	83.33333333
2.5	108	1100	10.18518519	84.87654321
3	108	1120	10.37037037	86.41975309
3.5	108	1120	10.37037037	86.41975309
4	108	1120	10.37037037	86.41975309
4.5	108	1100	10.18518519	84.87654321
5	108	1100	10.18518519	84.87654321

Table 1: Experimental Values

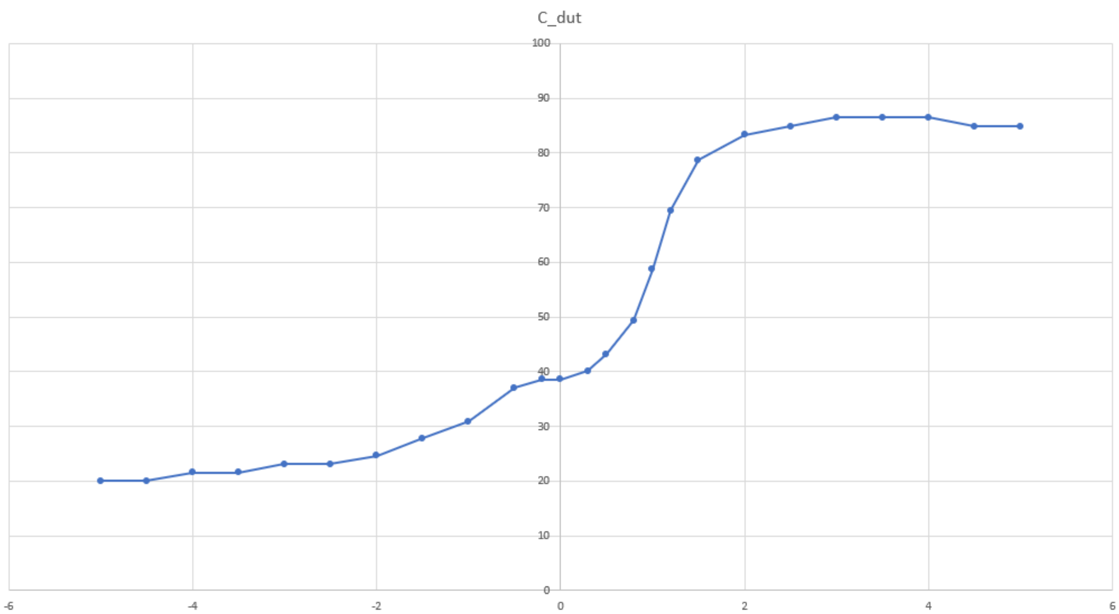


Figure 1: Plot Obtained for C-V characteristics for DUT

3.3 Amplifier Circuit

Output Voltage Amplitude observed was, 102mV when input frequency = 100kHz, 48.7mV when input frequency = 5kHz

4 Calculations

After substituting the values in the formulae we obtain the following results

Area A = 0.000004 m^2
Oxide Capacitance = 86.53 nF
Oxide thickness = 1.598 nm
Doping density = 1.83 x 10^{32} m^{-3}
Flat band voltage = -4 V
Flat band capacitance = 4.245629 x 10^{-13} F
Debye length = 0.000762819
Debye capacitance = 4.27263 x 10^{-13} F