READ ME file for DATA set for article titled ‘DEVELOPMENT OF SYSTEMATIC FITTING MODEL FOR NONLINEAR NANOELECTROMECHANICAL RESONANCE ANALYSIS’

DATASET DOI: 10.5258/SOTON/D1592

READ ME author: FANG BEN, ECS, Faculty of Engineering and Physical Sciences, University of Southampton, SO17 1BJ, UK

This dataset supports the publication:

AUTHORS: F. Ben, J. Fernando, J. Ou, and Y. Tsuchiya

TITLE: ‘Development of Systematic Fitting Model for Nonlinear Nanoelectromechanical Resonance Analysis’

Conference: IEEE MEMS 2021

PAPER DOI:

This dataset contains:

All figures that appear in the publication in the folder “Figures”.

Raw data for measurement and simulation for each figure in the folder “Raw\_data”.

Figures in the publication (Figure 1, 2, 3, 4, 5) correspond to the files in the folder “Figures” as follows;

FIG1; Figure1.png

FIG2; Figure2.png

FIG3; Figure3.png

FIG4; Figure4.png

FIG5; Figure5.png

Date of data collection: Experiment: 12th February 2020; Model simulation: 20th October 2020

Information about geographic location of data collection: Experiment data was collected in Cryogenic Prober Station in Room 2022 Building 53, University of Southampton. UK, SO17 1BJ

Licence:

Related projects:

Date that the file was created: 7th December 2020

Figure 1 and Figure2 (a) are a diagram created via 3D Paint, Figures 2(b),2(C), Figure 4, Figure 5 were plotted by Origin 2019. Data were based on experimental and simulation (MATLAB2020) data. Below are the explanations of how each figure was generated using the raw data.

Figure 1 (a) A top view of NEMS beam. (b) A scheme of cross-sectional view showing silicon nano-beam vibration characteristics. (c) A diagram of whole sample in 3-dimension mode. Created via 3D Paint

Figure 2 (a) Diagram that schematically shows the resonance measurement set up by using FM detection method; Experimental results for Sample S1 (L=2um) with respect to 2V Vdc. (b) Resonance frequency at 97.53MHz with driven power at -9dBm. (c) Resonance frequency at 97.65MHz with driven power at -4dBm.

Figure2(a) was created via 3D Paint. Figure 2(b) and 2(c) are experimental data plotted via Origin2019

Figure 3 A summary of model fitting results regarding sample S1 power dependence measurement. (a)DC bias at 1V. (b)DC bias at 2V. (c) DC bias at 3V. (d) Siz AC dependence at Vdc = 2 V.

Figure 4 (a) Sample S1 DC dependence measurement result and model fitting. (b) Siz DC dependence. (c) Siz AC dependence

Figure 5: Power dependence model fitting result. (a)Sample S2 L=1.5um. (b) Sample S3 L=1um

The following data were used;

Vg\_1V\_Sample\_L2um\_P\_1tomin4dbm.csv

Vg\_2V\_Sample\_L2um\_P\_min4tomin9dbm.csv

Vg\_3V\_Sample\_L2um\_P\_min7tomin12dbm.csv

Vg\_4V\_Sample\_L1p5um\_P\_1to6dbm.csv

Vg\_8V\_Sample\_L1um\_P\_3to8dbm.csv

Vg\_effect\_Sample\_L2um.csv

(1)

The following data were used;

Vg\_1V\_Sample\_L2um\_P\_1tomin4dbm.csv

Data from sample with 2um length. Data were categorized into model (simulation) and experiment. Model results were simulated via MATLAB 2020a. Experimental results were collected by cryogenic prober station in vacuum and room temperature. Back-gate voltage bias was set to 1V. Driven power applied through beam was swept from -4dBm to 1dBm. Same conditions were used in model simulation.

The entire data set was plotted in Figure 3(a)

(2)

The following data were used;

Vg\_2V\_Sample\_L2um\_P\_min4tomin9dbm.csv

Data from sample with 2um length. Data were categorized into model (simulation) and experiment. Model results were simulated via MATLAB 2020a. Experimental results were collected by cryogenic prober station in vacuum and room temperature. Back-gate voltage bias was set to 2V. Driven power applied through beam was swept from -4dBm to 1dBm. Same conditions were used in model simulation.

The entire data set was plotted in Figure 3(b)

(3)

The following data were used;

Vg\_3V\_Sample\_L2um\_P\_min7tomin12dbm.csv

Data from sample with 2um length. Data were categorized into model (simulation) and experiment. Model results were simulated via MATLAB 2020a. Experimental results were collected by cryogenic prober station in vacuum and room temperature. Back-gate voltage bias was set to 3V. Driven power applied through beam was swept from -12dBm to -7dBm. Same conditions were used in model simulation.

The entire data set was plotted in Figure 3(b)

(4)

The following data were used;

Vg\_effect\_Sample\_L2um.csv

Data from sample with 2um length. Data were categorized into model (simulation) and experiment. Model results were simulated via MATLAB 2020a. Experimental results were collected by cryogenic prober station in vacuum and room temperature. Driven power was set to -3dBm. Back-gate voltage was swept from 1.0V to 1.6V with 0.2V increasing step.

The entire data set was plotted in Figure 4

(5)

The following data were used;

Vg\_4V\_Sample\_L1p5um\_P\_1to6dbm.csv

Data from sample with 1.5um length. Data were categorized into model (simulation) and experiment. Model results were simulated via MATLAB 2020a. Experimental results were collected by cryogenic prober station in vacuum and room temperature. Back-gate voltage bias was set to 4V. Driven power applied through beam was swept from 1dBm to 6dBm. Same conditions were used in model simulation.

The entire data set was plotted in Figure 5(a)

(6)

The following data were used;

Vg\_8V\_Sample\_L1um\_P\_3to8dbm.csv

Data from sample with 1um length. Data were categorized into model (simulation) and experiment. Model results were simulated via MATLAB 2020a. Experimental results were collected by cryogenic prober station in vacuum and room temperature. Back-gate voltage bias was set to 8V. Driven power applied through beam was swept from 3dBm to 8dBm. Same conditions were used in model simulation.

The entire data set was plotted in Figure 5(b)

TABLE I

The extracted value of quality factor and mechanical cubic nonlinear stiffness beta\_m with different samples.