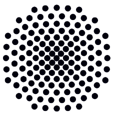

Universität Stuttgart

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Raum 1.444

30.04.2024

Bachelorarbeit / Forschungsarbeit / HiWi

Beginn: ab sofort

LE

Modellierung von GaN-Transistoren

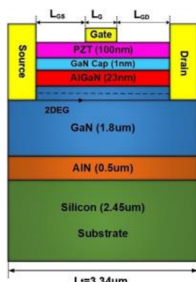
Die Verwendung von Leistungsbauelementen aus Galliumnitrid (GaN) in der Leistungselektronik ermöglicht es, Systeme zu miniaturisieren und die Leistungsdichte zu erhöhen. Das elektrische und thermische Verhalten dieser Bauelemente im Betrieb ist ein entscheidendes Kriterium bei der Auswahl der Transistoren. Im Rahmen dieser Arbeit sollen Modelle für verschiedene GaN-Leistungshalbleiter erstellt und miteinander verglichen werden.

Aufgaben

- Ableitung empirischer Modelle aus den Datenblattkurven der Transistoren.
- Anpassung eines vorhandenen physikalisch motivierten Modells (Verilog-A) für die jeweiligen Transistoren.
- Bewertung der Simulationsergebnisse der verschiedenen Modelle.
- Durchführung von Messungen zur Validierung der Modelle.

Ziel

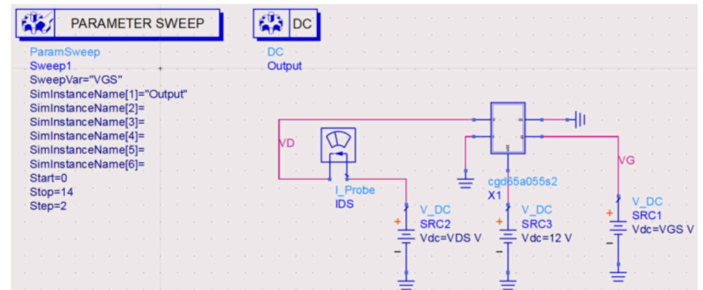
- Durchführung einer Genauigkeitsanalyse der verschiedenen Modelle.



Struktur eines GaN HEMT [1]

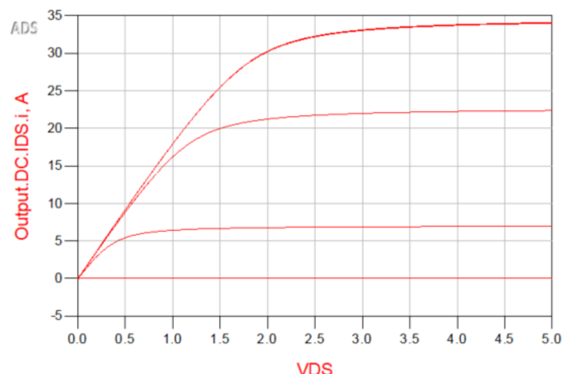
Die Arbeit beinhaltet

- Literaturrecherche
- Erstellung von empirischen und physikalischen Modellen der Transistoren
- Bewertung der Ergebnisse
- Validierung durch Messungen
- Dokumentation der Arbeit



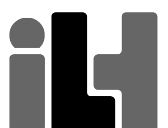
Model in ADS

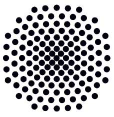
```
// Gate Current Model //////////
    if (gatemod == 1) begin
        t0 = V(gi, si)/(njgs*`KboQ*Tdev);
        t3 = igsdio + (Tdev/Tnom - 1.0)* ktgs;
        Igs = w*l*nf*abs(t3)*(lexp(t0)-1.0);
        t0 = V(gi, di)/(njgd*`KboQ*Tdev);
        t3 = igddio + (Tdev/Tnom - 1.0)* ktgd;
        Igd = w*l*nf*abs(t3)*(lexp(t0)-1.0);
        I(gi, si) <+ Igs;
        I(gi, di)  <+ Igd;
    end
```



Ausgangskennlinie

[1] https://www.researchgate.net/publication/338670635_Design_and_Analysis_of_High-Power_Device_Based_on_PZTAlGaNGaN_by_Ferroelectric-Gate_Heterojunction/figures?lo=1





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30.04.2024

Bachelor Thesis / Study Thesis / HiWi

Start: immediately

PE

Modeling of GaN transistors

The use of power components made of gallium nitride (GaN) in power electronics makes it possible to miniaturize systems and increase power density. The electrical and thermal behavior of these components during operation is a decisive criterion in the selection of transistors. Within the scope of this work, models for various GaN power semiconductors are to be created and compared with each other.

Tasks

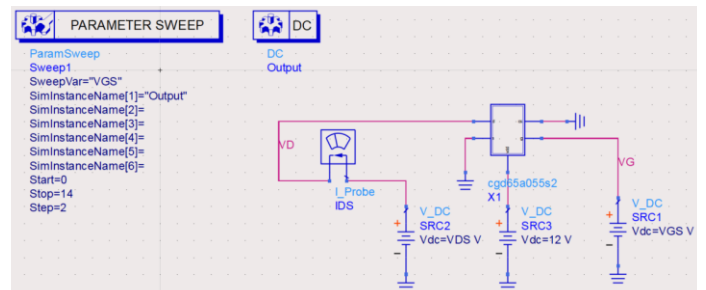
- Derivation of empirical models from the data sheet curves of the transistors.
- Adaptation of an existing physically motivated model (Verilog-A) for the respective transistors.
- Evaluation of the simulation results of the different models.
- Carrying out measurements to validate the models.

Goal

- Carrying out an accuracy analysis of the various models.

The work includes

- Literature research
- Creation of empirical and physical models of the transistors
- Evaluation of the results
- Validation through measurements
- Documentation of the work



Model in ADS

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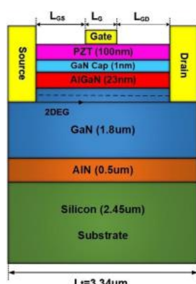
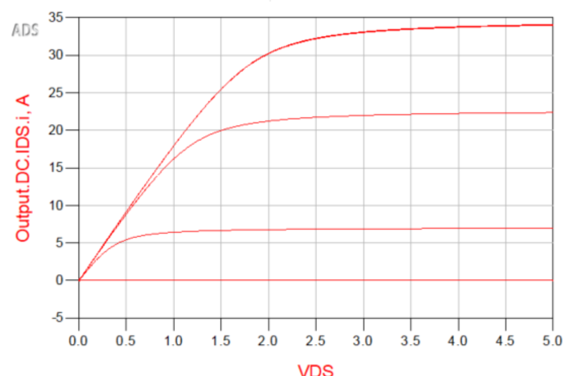
      Igs = w*l*nf*abs(t3)*(lexp(t0)-1.0);
      t0 = V(gi, di)/(njgd*`KboQ*Tdev);
      t3 = igddio + (Tdev/Tnom - 1.0)* ktgd;
      Igd = w*l*nf*abs(t3)*(lexp(t0)-1.0);
      I(gi, si) <+ Igs;
      I(gi, di)  <+ Igd;
   end
```



Structure of GaN HEMT [1]



Output characteristics

[1] https://www.researchgate.net/publication/338670635_Design_and_Analysis_of_High-Power_Device_Based_on_PZTAlGaNGaN_by_Ferroelectric-Gate_Heterojunction/figures?lo=1