PROCESSING OF THE BIMODAL ULTRAFINE GRAINED MICROALLOYED DUAL PHASE STEEL SHEETS

IITM Technology Available for Licensing

PROBLEM STATEMENT

- The **Steel processing industry** needs to produce **high-strength steels through optimization** of **steel chemsitry**, process parameters and microstructure.
- **Dual phase steels** are popular for **automotive applications** due to their strength and formability. **Grain refinement** is the only **method that improves strength** and toughness.
- **Ultrafine grained dual phase steels** with ferrite grain sizes **less than 1 µm** are gaining attention for their high strength, ductility, and low transition temperature.
- The invention **aims to enhance uniform elongation** and **strain hardening of ferrite-pearlite micro alloyed steel** for **automotive applications.**

TECHNOLOGY CATEGORY/ MARKET

Technology: Ultrafine Grained Micro alloyed Dual Phase Steel Sheets
Category: Advance Material & Manufacturing
Industry: Steel Processing and manufacturing
Application: Automobile application
Market: The global market size was valued at **USD 70.72 billion in 2022** and is **projected to reach USD 115.80 billion by 2030,** growing at a **CAGR of 6.54% from 2023 to 2030**

INTELLECTUAL PROPERTY

IITM IDF Ref.1138
Patent No: IN 343171

TRL (Technology Readiness Level)

TRL- 3, Experimental Proof of concept

Research Lab

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TECHNOLOGY

Processing of bimodal ultrafine grained microalloyed dual phase steel sheet, the said steel sheet

(i) Normalization

- **Normalization of a hot rolled microalloyed steel plate of 6 mm thickness at 930°C for 30 minutes to remove the pearlite banding**

(ii) Warm rolling

- **Warm rolling of normalized steel to a true strain of 2.4 in thickness**

(iii) Intercritical annealing

- **Intercritical annealing of warm rolled sheet at 700 - 800°C for 2 - 3 minutes in salt bath furnace followed by water quenching to room temperature,**
- **steel sheet is characterized by a heterogeneous grains of fine and ultrafine ferrite microstructure and**
- **Martensite dual phase steel, comprising a mixture of 50 vol. % to 85 vol. % of polygonal ferrite dispersed with 15 vol. % to 50 vol. % of colonies of lath martensite and 2-4 nm niobium carbonitrides (Nb(C, N)) and vanadium carbonitrides (V(C, N)) precipitates,**
- **where the chemical composition of the microalloyed steel in wt% is C (0.12 - 0.20), Si (0.2 - 0.45), Mn (1.0 -2.0), Nb (0.015 -0.03), V (0.05 - 0.08), S (0.006 - 0.008), P (0.009 - 0.013), N (0.009 - 0.012) and the remaining is Fe.**

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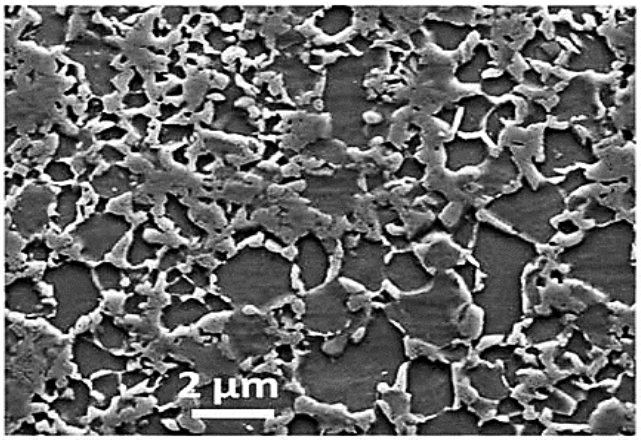


Fig. 1 provides a schematic diagram of microstructure of bimodal ultrafine grained dual phase steel following warm rolling (to true strain 2.4) and intercritical annealing at 760°C for 2min

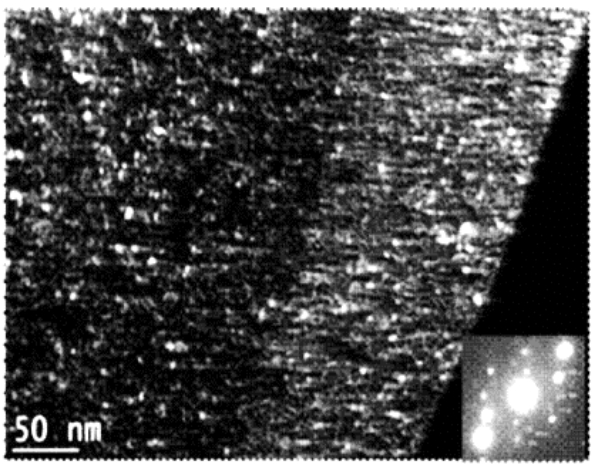
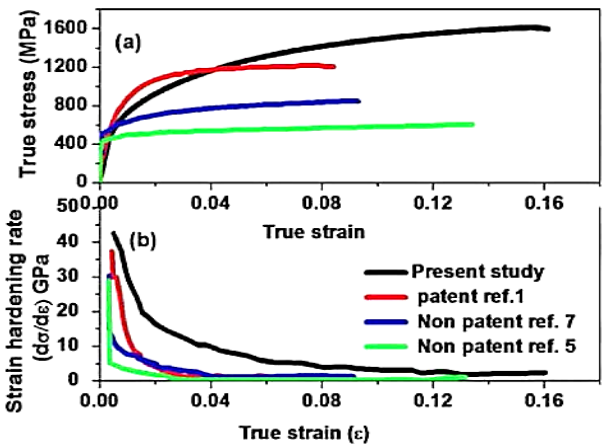


Fig. 2 provides a schematic drawing shows V(C, N) and Nb(C, N) precipitates with size of 2 - 4 nm

Key Features / Value Proposition

- **Ferrite Grains Size**
  - Ultrafine ferrite grains: **0.5-1 µm**,
  - Fine ferrite grains: **1-5 µm**,
  - percentages:60-70%,30-40% respectively.
- **Processed steel sheet thickness:**
  - Thickness of **0.5 mm.**
- **Tensile strength**
  - Range of **1200-190 MPa**
- **Uniform elongation**
  - Range of **16-25%.**
- **Ultimate tensile strength and uniform elongation product**
  - Range over **23000 MPa%.**
- **Application**
  - Processes bimodal ultrafine grained microalloyed **dual phase steel sheets** for automotive applications.
- Utilizes methods like **warm rolling and intercritical annealing.**
- Offers **simple** working procedure and industrially scalable prospects.
- **Performance**
  - **Exhibits excellent formability,**
  - **High tensile strength,**
  - **High uniform elongation,**
  - **Superior toughness,**
  - **Workability and weldability**.



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