

ARCTIC-GRADE MATERIAL COMPOSITION PATENT

ARCTIC-GRADE MATERIAL COMPOSITION

United States Patent Application No. 16/789,432

Filing Date: March 15, 2022

Assignee: Polar Dynamics Robotics, Inc.

ABSTRACT

A composition of materials and manufacturing process for creating arctic-grade robotic components capable of maintaining structural integrity and operational effectiveness in extreme cold environments ranging from -40 C to -5 C.

composition comprises a proprietary blend of reinforced thermopolymers, cold-resistant elastomers, and nano-engineered surface treatments that ensure consistent performance in sub-zero industrial applications.

BACKGROUND OF INVENTION

[0001] Autonomous mobile robots operating in cold storage and industrial environments face significant materials engineering challenges, including thermal stress, condensation management, and mechanical property degradation at low temperatures.

[0002] Conventional robotic materials exhibit reduced flexibility, increased brittleness, and compromised seal integrity when exposed to sustained low-temperature conditions, leading to premature component failure and reduced operational reliability.

SUMMARY OF INVENTION

[0003] The present invention provides a novel material composition specifically engineered for extreme cold environment robotics applications, comprising:

- a) A primary structural matrix consisting of modified polyether ether ketone (PEEK) reinforced with carbon nanofibers (40-60% by weight)
- b) A secondary elastomeric component utilizing proprietary cross-linked fluorosilicone compounds (15-25% by weight)
- c) Surface treatment incorporating plasma-deposited fluoropolymer coating and integrated moisture management channels

DETAILED DESCRIPTION

Material-Composition

[0004] The primary structural matrix utilizes a proprietary blend of:

-

Modified PEEK polymer base (Patent No. 15/443,221)

-

Carbon nanofiber reinforcement (5-15 m diameter)

-

Thermal stability additives (2-5% by weight)

-

Impact modification compounds (3-8% by weight)

[0005] The elastomeric component comprises:

-

Cross-linked fluorosilicone base compound

- - 4 -

Cold-flexible plasticizer system

-

Anti-oxidation stabilizers

-

UV protection additives

Manufacturing Process

[0006] The manufacturing process includes:

Precision compounding of primary matrix components under controlled conditions

Two-stage injection molding with integrated fiber alignment

Plasma surface treatment and fluoropolymer coating application

Proprietary thermal cycling and stress relief protocol

CLAIMS

A material composition for arctic-grade robotic components comprising:

- a) Modified PEEK polymer matrix (40-60% by weight)
- b) Carbon nanofiber reinforcement (15-25% by weight)
- c) Proprietary elastomeric compounds (15-25% by weight)
- d) Surface treatment system (remaining %)

The composition of claim 1, wherein said material maintains operation at temperatures below -40°C.

The manufacturing process of claim 1, comprising:

- a) Controlled atmosphere compounding
- b) Multi-stage injection molding
- c) Plasma surface treatment

d) Thermal cycling protocol

DRAWINGS

[0007] Figure 1: Molecular structure diagram of modified PEEK matrix

[0008] Figure 2: Cross-sectional view of nanofiber reinforcement distribution

[0009] Figure 3: Surface treatment layer composition

[0010] Figure 4: Thermal cycling protocol diagram

INVENTORS

-

Dr. James Barrett, Chief Robotics Officer

-

Dr. Marcus Chen, Chief Technology Officer

- 7 -

Dr. Sarah Wong, Principal Materials Engineer

PATENT ATTORNEYS

Frost & Richardson LLP

1000 Technology Square

Boston, MA 02142

ASSIGNMENT

All rights, title, and interest in this patent application are assigned to P
Dynamics Robotics, Inc., a Delaware corporation having its principal p
business at 2500 Robotics Way, Cambridge, MA 02142.

DECLARATION

I hereby declare that all statements made herein of my own knowledge and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that false statements and the like so made are punishable by fine or imprisonment, both, under Section 1001 of Title 18 of the United States Code.

Executed on: March 15, 2022

/s/ Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.

