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**Wang et al.**

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(54) **APPLICATION OF ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY IN SENSOR SYSTEMS, DEVICES, AND RELATED METHODS**

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See application file for complete search history.

(71) Applicant: **MEDTRONIC MINIMED, INC.**, Northridge, CA (US)

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(72) Inventors: **Jenn-Hann Larry Wang**, Northridge, CA (US); **Michael E. Miller**, Culver City, CA (US); **Raghavendhar Gautham**, Los Angeles, CA (US); **Yiwen Li**, Arcadia, CA (US); **Rajiv Shah**, Rancho Palos Verdes, CA (US)

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(73) Assignee: **MEDTRONIC MINIMED, INC.**, Northridge, CA (US)

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*Primary Examiner* — Arleen M Vazquez

*Assistant Examiner* — Alesa Allgood

(74) *Attorney, Agent, or Firm* — Pillsbury Winthrop Shaw Pittman LLP

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(58) **Field of Classification Search**

CPC .. G01R 35/00; G01R 35/005; A61B 5/14532; A61B 5/14865; A61B 5/1495; A61B 5/1473; A61B 5/7221; A61B 5/0537; A61B 5/1459; A61B 5/746; A61B 5/1468; A61M 5/14276;

(57) **ABSTRACT**

A diagnostic Electrochemical Impedance Spectroscopy (EIS) procedure is applied to measure values of impedance-related parameters for one or more sensing electrodes. The parameters may include real impedance, imaginary impedance, impedance magnitude, and/or phase angle. The measured values of the impedance-related parameters are then used in performing sensor diagnostics, calculating a highly-reliable fused sensor glucose value based on signals from a plurality of redundant sensing electrodes, calibrating sensors, detecting interferents within close proximity of one or more sensing electrodes, and testing surface area characteristics of electroplated electrodes. Advantageously, impedance-related parameters can be defined that are substantially glucose-independent over specific ranges of frequencies. An Application Specific Integrated Circuit (ASIC) enables implementation of the EIS-based diagnostics, fusion algorithms, and other processes based on measurement of EIS-based parameters.

**17 Claims, 72 Drawing Sheets**

