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Pelrine et al.

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(54) **SURFACE DEFORMATION
ELECTROACTIVE POLYMER
TRANSDUCERS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 298 days.

This patent is subject to a terminal disclaimer.

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(58) **Field of Classification Search** **381/152, 381/170-176, 191, 369, 399, 431**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,342,936 A 8/1982 Marcus et al.

(Continued)

FOREIGN PATENT DOCUMENTS

JP 2001-286162 10/2001

(Continued)

OTHER PUBLICATIONS

Ajluni, C., "Pressure Sensors Strive to Stay on Top, New Silicon Micromachining Techniques and Designs Promise Higher Performance", *Electronic Design—Advanced Technology Series*, Oct. 3, 1994, pp. 67-74.

(Continued)

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(57) **ABSTRACT**

The present invention provides electroactive polymer transducers that produce out-of-plane deflections. The transducers form a set of surface features based on deflection of an electroactive polymer. The set of surface features may include elevated polymer surface features and/or depressed electrode surface features. Actuation of an active area may produce the polymer deflection that creates one or more surface features. A passive layer may operably connect to a polymer. The passive layer may comprise a thicker and softer material to amplify polymer thickness changes and increase surface feature visibility.

1 Claim, 12 Drawing Sheets

