CLAIMS

1. A thermoelectric module comprising:

a substrate comprising a surface, the surface comprising a first region and a second region opposite to each other;

a first leg formed of a ~~first~~ p-type material ~~of a first doping type forming a~~, the first leg extending on ~~a~~ the substrate surface ~~of the substrate~~, the first leg comprising a first end oriented towards ~~a~~ the first region of the substrate surface and a second~~, opposite~~ end oriented towards ~~a~~ the second region of the substrate surface, the first and second ends of the first leg being opposite to each other; and

a second leg formed of an ~~second~~ n-type material ~~of a second doping type forming a~~, the second leg extending on the substrate surface ~~of the substrate~~, the second leg comprising a first end oriented towards the first region of the substrate surface and a second~~, opposite~~ end oriented towards the second region of the substrate surface, the first and second ends of the second leg being opposite to each other,

~~such that~~wherein the first and second legs are substantially parallel to each other,

wherein the first end of the first leg is in electrical connection with the first end of the second leg, ~~and~~

wherein the ~~first and second doping types~~p-type material and the n-type material have opposite polarity,

such that when a heat flux is applied between the first region and the second region of the substrate surface, a potential difference arises between the second end of the first leg and the second end of the second leg, ~~and~~

wherein the substrate, the first ~~material~~leg, and the second ~~material~~ leg are substantially transparent to visible light, and

wherein the n-type material comprises low-temperature indium tin oxide.

2. The thermoelectric module of claim 1,

wherein the first end of the first leg and the first end of second leg are in electrical connection via a direct interface between the first ~~material~~ leg and the second ~~material~~leg.

3. The thermoelectric module of claim 1, further comprising an electrical bridge between the first end of the first leg and the first end of the second leg,

wherein the first end of the first leg and the first end of the second leg are in electrical connection via ~~an~~ the electrical bridge ~~between the first material and the second material~~.

4. The thermoelectric module of claim 3, wherein the electrical bridge is substantially transparent to visible light.

5. The thermoelectric module of claim 4, wherein the electrical bridge is formed from at least one of poly(3,4-ethylenedioxythiophene), polyaniline, copper

iodide, indium tin oxide, aluminium doped zinc oxide, gallium-doped zinc oxide, aluminium- and gallium- co-doped zinc oxide and fluorine-doped tin oxide.

6. The thermoelectric module of any one of ~~the preceding~~ claims 1 to 5, the thermoelectric module having a visible light transmittance of greater than 50%.

~~7. A thermoelectric module comprising:~~

~~a substrate;~~

~~a first material of a first doping type forming a first leg extending on the surface of the substrate, the first leg comprising a first end oriented towards a first region of the surface and a second, opposite end oriented towards a second region of the surface; and~~

~~a second material of a second doping type forming a second leg extending on the surface of the substrate, the second leg comprising a first end oriented towards the first region of the surface and a second, opposite end oriented towards the second region of the surface, such that the first and second legs are substantially parallel to each other,~~

~~wherein the first end of the first material and the first end of the second material are in electrical connection via a direct interface between the first material and the second material, and~~

~~wherein the first and second doping types have opposite polarity,~~

such that when a heat flux is applied between the first region and the second region of the surface, a potential difference arises between the second end of the first material and the second end of the second material.

87. The thermoelectric module of any one of the preceding claims 1 to 6, wherein the first p-type material comprises at least one of poly(3,4-ethylenedioxythiophene), polyaniline and copper iodide.

98. The thermoelectric module of claim 87, wherein the first p-type material comprises poly(3,4-ethylenedioxythiophene) doped with poly(styrene sulfonate) anions.

109. The thermoelectric module of claim 98, wherein the first p-type material comprises poly(3,4-ethylenedioxythiophene) doped with poly(styrene sulfonate) anions and post-treated with a mixture of trifluoromethanesulfonic acid and methanol.

11. The thermoelectric module of any of the preceding claims, wherein the second material comprises at least one of indium tin oxide, aluminium doped zinc oxide, gallium doped zinc oxide, aluminium and gallium co-doped zinc oxide, and fluorine-doped tin oxide.

12. The thermoelectric module of any one of the preceding claims, wherein the second material comprises low-temperature indium tin oxide.

~~13~~10. The thermoelectric module of any one of ~~the preceding~~ claims 1 to 9, wherein the substrate comprises at least one of glass polyethylene terephthalate, and polycarbonate.

~~14~~11. The thermoelectric module of any one ~~of the preceding~~ claims 1 to 10, wherein the first leg~~material~~ and the second leg~~material~~ have a thickness of no more than 500 nm.

~~15~~12. The thermoelectric module of any one ~~of the preceding~~ claims 1 to 11, further comprising:

a first heat couple plate in thermal connection with the first region of the substrate surface; and a second heat couple plate in thermal connection with the second region of the substrate surface, and

wherein one of the heat couple plates is configured to act as a heat source and the other heat couple plate is configured to act as a heat sink.

~~16~~13. A thermoelectric generating device comprising an array of interconnected thermoelectric modules according to any one of claims 1 to ~~15~~12.

~~17~~14. A method of producing a thermoelectric module according to any one of claims 1 to ~~15~~13, the method comprising depositing the ~~first~~ p-type and ~~second~~ n-type materials on the substrate surface ~~of the substrate~~ using at least one of spray-coating, spin-coating, drop-casting, blade coating, roll to roll and other thin film

printing methods, atomic layer deposition (ALD), sputtering, chemical vapor deposition (CVD), plasma vapor deposition (PVD) and thermal evaporation nano-thin film fabrication methods.