

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* JEAN-MICHEL FAVROT  
and PHILIPPE LAUBRY

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Appeal 2008-0389  
Application 11/253,785  
Technology Center 1700

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Decided: April 8, 2008

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Before CATHERINE Q. TIMM, LINDA M. GAUDETTE, and  
MICHAEL P. COLAIANNI, *Administrative Patent Judges*.

GAUDETTE, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 1 and 3-12, the only claims pending in the application. App. Br. 2. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

The invention relates to amino-functionalized diene polymers prepared by a process which results in formation of 1,4-trans linkage content which is at least 70%. Spec. 6, ll. 2-4. These polymers are used, for example, in formulating rubber compositions for use in tire casings. Spec. 5,

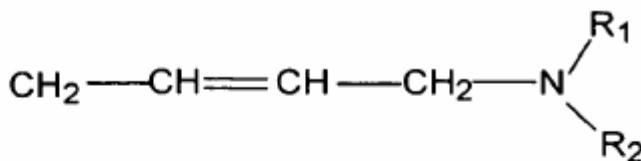
ll. 15-18. According to the inventors, known processes exist for preparation of polybutadienes having a 1,4-trans linkage content of at least 70%. Spec. 1, l. 5 - 2, l. 3 and Spec. 3, ll. 9-12. In two of these known processes, the monomers are reacted in the presence of an organolithium initiator and a co-catalyst comprising, e.g., a barium compound and a compound of a group IIIA metal. Spec. 2, ll. 3-7 and Spec. 3, ll. 9-12. The inventors note that these two known processes do not relate to forming functional polymers.

Spec. 3, ll. 13-14. According to the inventors, processes for preparation of diene polymers which are amino-functionalized are also known in the art.

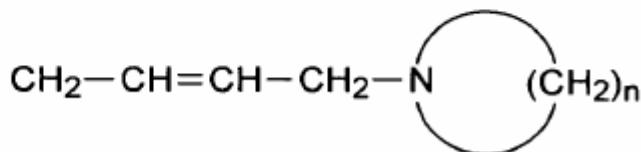
Spec. 3, ll. 15-17 and Spec. 4, ll. 13-14. However, the polymers obtained by these processes have a 1,4 trans linkage content of less than 70%. Spec. 3, ll. 19-20 and Spec. 4, ll. 17-18. According to the inventors, they have discovered that preparation of amino-functionalized diene polymers having a 1,4-trans linkage content of at least 70% is possible by using the specific catalytic system recited in claim 1 (*see* Spec. 5, ll. 2-14), reproduced below:

1. An amino-functionalized diene polymer having a high 1,4-trans linkage content and an amino function situated at an end of the polymer chain,

-wherein the amino function is a grafted noncyclic tertiary amino function, such that the end of the polymer corresponds to the formula:



or



-wherein R<sub>1</sub> and R<sub>2</sub> are each an alkyl group, the number of carbon atoms of the R<sub>1</sub> and R<sub>2</sub> set ranging from 2 to 15, n being the whole number ranging from 2 to 15,

-the functionalization rate of said polymer is equal to or greater than 50%, and

-the 1,4-trans linkage content is equal to or greater than 70%,

and where the amino-functionalized diene polymer is prepared by a process which comprises contacting a diene monomer with a catalyst system consisting essentially of at least one hydrocarbon solvent, a compound A of a group IIIA metal, a compound B of an alkaline earth metal, and an aminolithium initiator C.

The Examiner relies on the following prior art references to show unpatentability:

Shimada (as translated)	JP 01-234409	Mar. 16, 1988
Suzuki	5,248,736	Sep. 28, 1993
Shimizu	EP 0 6661 298 A2	Dec. 29, 1994

The Examiner made the following rejection:

Claims 1 and 3-12 under 35 U.S.C. § 103 as unpatentable over Shimizu in view of Shimada and Suzuki.

The Examiner finds that Shimizu discloses the claimed amino-functionalized diene polymer with the exception of an explicit teaching/example of a 1,4-trans linkage content of 70% or more as claimed. Answer 3. The Examiner contends that it would have been obvious to have modified Shimizu's process to produce the claimed amino-functionalized diene polymer based on Shimada's and Suzuki's disclosures of the various benefits associated with a high 1,4-trans linkage content. Answer 3-4. The Examiner specifically points out that Shimada employs a barium compound randomizer in combination with an organolithium initiator to achieve a high 1,4-trans linkage content in a diene polymer. The Examiner notes that Shimizu discloses examples in which an amide lithium initiator is combined with a potassium t-amylate randomizer to produce an amino-functionalized diene polymer with a high cis-1,4 content. Answer 7. The Examiner maintains that replacing the potassium t-amylate with a barium randomizer in Shimizu's examples would have produced an amino-functionalized polymer having Appellants' claimed 1,4-trans linkage content. Answer 7.

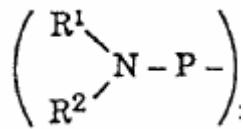
Appellants argue that one of ordinary skill in the art would not have had a reasonable expectation of success in modifying Shimizu's process to obtain a functionalized diene polymer having a 1,4-trans linkage content of 70% or more as claimed. App. Br. 7-8. Appellants argue that there is no teaching or suggestion in Shimada that "a barium compound and a lithium compound alone as a catalyst could produce a diene polymer having a high trans-1,4 content." Reply 6. Rather, Appellants maintain that Shimada's teaching is limited to the use of a specific "4-component catalyst system containing a barium compound, an aluminum compound, a magnesium

compound and a lithium compound to prepare a butadiene rubber having 87% trans-1,4 structure.” Reply 6. Appellants likewise contend that Suzuki suggests nothing more than a process for improving “tensile strength, wear resistance, rebound resilience, heat build-up, wet skid resistance and processability . . . by reacting the alkaline earth metal end groups of a high trans-1,4 diene polymer with CO<sub>2</sub> or CS<sub>2</sub> and preferably also with an N-substituted compound.” App. Br. 7.

Based on the contentions of the Examiner and the Appellants, the first issue presented is: Has the Examiner provided a reasonable basis to conclude that it would have been *prima facie* obvious, within the meaning of 35 U.S.C. § 103, to have modified Shimizu’s polymer to obtain Appellants’ claimed amino-functionalized diene polymer? For the reasons discussed below, we answer this question in the affirmative. Appellants also present evidence in the form of a declaration in an effort to refute the Examiner’s conclusion of obviousness. Therefore, a second issue presented is: Have Appellants shown that a preponderance of the evidence weighs in favor of a finding of non-obviousness? We answer this question in the negative.

The following Findings of Fact are relevant to our consideration of this issue:

- 1) Shimizu discloses preparation of a functionalized polymer represented by formula (1) by initiating polymerization of a monomer using a lithium amide initiator. p. 8, ll. 25-26. Shimizu’s formula (1) includes the following structure:



where P represents a diene-type polymer and R<sup>1</sup> and R<sup>2</sup> may be the same or different and are each selected from the group consisting of an aliphatic hydrocarbon group, an alicyclic hydrocarbon group and an aromatic hydrocarbon group, each having 20 or less carbon atoms. Shimizu 4, ll. 49-51.

- 2) According to Shimizu, the lithium amide initiator may be lithium "hexamethyleneimine." Shimizu 8, ll. 26-27.
- 3) According to Shimizu, addition of a randomizer is preferable "in order to obtain a polymer having a desired molecular structure." Shimizu 14, ll. 33-34. Shimizu further explains that a "randomizer is a compound which controls, for example: the microstructure of a conjugated diene polymer, such as the amount of the 1,2 linkage in polybutadiene. Shimizu 14, ll. 34-36.
- 4) Shimizu states that "[t]he randomizer . . . is not particularly limited." Shimizu 14, ll. 38-39. Shimizu lists four exemplary groups of randomizers, including compounds represented by the formula (RO)<sub>2</sub>M<sup>2</sup> where "R is selected from an aliphatic hydrocarbon group, an alicyclic hydrocarbon group, and an aromatic hydrocarbon group, M<sup>2</sup> represents an alkaline earth metal, such as calcium or barium." Shimizu 14, ll. 40-50.
- 5) In Example 1, Shimizu discloses preparation of a functionalized polymer prepared by combining cyclohexane, butadiene monomer, styrene monomer, potassium t-amylate and di-n-hexylamine (DHA)and n-butyllithium. Shimizu 17-18.
- 6) Shimada discloses "a method for producing conjugated diene polymers having high content of trans-1,4 bond . . . and excellent wear resistance and mechanical properties . . . by polymerizing conjugated dienes

. . . in the presence of catalyst systems containing (a) barium compounds, (b) organoaluminum compounds, (c) organomagnesium compounds, and (d) organolithium alkoxides and/or organolithium amides.” Shimada 1<sup>1</sup>. The catalyst system is prepared by dissolving components (a)-(d) in inert organic solvents. Shimada 5.

7) Suzuki “relates to a process for producing a diene polymer having markedly improved tensile strength and wear resistance and . . . to a rubber composition containing a terminal diene polymer having a high content of a trans-1,4 bond of a conjugated diene moiety.” Suzuki, col. 1, ll. 8-10 and 15-17.

8) According to Suzuki’s process, conjugated diene monomer or a mixture of conjugated diene monomer and aromatic vinyl monomer is polymerized in a hydrocarbon solvent using a composite catalyst containing an alkaline earth metal such as barium (col. 4, ll. 24-26) to produce a diene polymer having active ends. Suzuki, col. 4, ll. 64-68. The active ends are then reacted with a specific compound to produce the modified diene polymer. Suzuki, col. 5, ll. 1-2. According to Suzuki, properties of the diene polymer can be greatly improved by using an active diene polymer having not less than 75% by weight of a trans-1,4 bond.” Suzuki, col. 7, ll. 21-23.

“If the product in a product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.” *In re Thorpe*,

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<sup>1</sup> We refer to the pagination of the Shimada translation, not the pagination of the original foreign language text provided in the margin of the translation.

777 F.2d 695, 697 (Fed. Cir. 1985). As explained by the Supreme Court, “[i]f a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1740 (2007).

Appellants' arguments focus on the obviousness/nonobviousness of combining the applied prior art to achieve the claim 1 process limitations. In so doing, Appellants fail to address the relevant inquiry, which is whether one of ordinary skill in the art would have recognized that known prior art techniques (e.g., those of Shimada and Suzuki) for improving the properties of diene polymers could readily be applied to improve the properties of Shimizu's amino-functionalized diene polymer. Thus, Appellants' arguments are not persuasive in establishing that the Examiner erred in rejecting the appealed claims as obvious over Shimizu in view of Shimada and Suzuki.

To the contrary, we find that the facts and reasons relied on by the Examiner provide a reasonable basis to conclude that one of ordinary skill in the art would have been motivated to optimize Shimizu's process to obtain a 1,4-trans linkage content of equal to or greater than 70% in the resultant amino-functionalized diene polymer. More specifically, the Examiner properly relied on the teaching of Suzuki to establish that one of ordinary skill in the art would have been motivated to use a trans-1,4 content of the conjugated diene moiety of at least 75% by weight in order to insure adequate tensile strength and wear resistance. Ans. 4; FF 7, 8. The

Examiner identified a known technique for providing a 1,4 trans-linkage content of at least 75% in a conjugated diene monomer, e.g. Shimada's catalyst system containing (a) barium compounds, (b) organoaluminum compounds, (c) organomagnesium compounds, and (d) organolithium alkoxides and/or organolithium amides." Ans. 3-4; FF 6. The Examiner further established that application of these known techniques in Shimizu's process would have been within the skill of the ordinary artisan by noting that Shimizu specifically identifies the use of a randomizer such as a barium compound as desirable in an aminolithium initiated anionic polymerization system. Ans. 3; FF 1-5.

Appellants rely on the Declaration of Pierre Robert to establish that one of ordinary skill in the art would not have had a reasonable expectation of success in modifying Shimizu's process in accordance with the teachings of Shimada and Suzuki given the notorious unpredictability of catalyst mechanisms. App. Br. 8. The Robert Declaration compares the results obtained from polymerization of butadiene in a mixture of trioctylaluminum, barium bis-ethyldiglycolate and either butyllithium (Example 1) or lithium hexamethylene imide (Example 2). According to the declarant:

The above data clearly shows that one can obtain diene polymers having a high 1,4-trans content using a catalyst system containing a lithium compound, a trialkyl aluminum and a barium compound as in Example 1. However, when one substitutes a lithium imide for the lithium compound in the catalyst system of Example 1, the resultant polymers will have a high 1,4-trans content but acceptable amine functionalization is not obtained. It is my opinion that one of ordinary skill in this art could not reasonably expect that admixing an amine functionalizer such as a lithium imide initiator with a barium randomizer would yield diene polymers having both high amine functionalization and high 1,4-trans content.

Robert Declaration 4.

Considering the arguments of the Examiner and Appellants anew in light of this evidence, we remain of the opinion that a preponderance of the evidence favors the Examiner's conclusion of obviousness. As noted above, patentability of a product-by-process claim is dependent on whether the claimed *product* would have been obvious to one of ordinary skill in the art at the time of the invention. The declarant analyzed the effect of replacing one specific organolithium initiator with one specific aminolithium initiator in a single catalyst system (specific components in specific amounts). Such analysis is not commensurate in scope with Appellants' broadly claimed catalyst system and is simply not sufficient to rebut the Examiner's finding that only routine optimization of Shimizu's process (based on known techniques such as those of Shimada and Suzuki) would have been required to obtain Appellants' claimed polymer.

#### ORDER

The decision of the Examiner rejecting claims 1 and 3-12 under 35 U.S.C. § 103 as unpatentable over Shimizu in view of Shimada and Suzuki is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(i)(iv).

AFFIRMED

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